

HS2

Scope Document – 'Compendium Version' Railway Systems Contracts

Document no: HS2-HS2-SY-SPE-000-000014

Revision	Date approved	Reason for revision
P01	17 th June 2020	First issue Additions from previously released HRS23 CCS and TM and HRS13-18 Track Systems versions included in Appendix 2 amendments table for information.
P02	26 th June 2020	Update to text in Preface and Sections 1 and 4 to clarify number of OCS contracts to be awarded, use of the term Candidate due to PACC and the maintenance requirements. Deletion of reference to CPD under a separate contract in Section 5 M&E.
P03	8 th July 2020	Cross-reference formatting error fixed at 11.2.1.

Contents

Preface	vi
1 Introduction	1
1.2 HS2	1
1.3 HS2 Ltd	2
1.4 HS2 route description	2
1.5 Railway Systems Contractors and Others	5
2 Contractor’s general obligations	7
2.1 Introduction	7
2.2 Human resources and contract administration	7
2.3 Systems integration	8
2.4 Design, environmental requirements and consents	9
2.5 Design and Building Information Modelling (BIM)	10
2.6 Safety	10
2.7 Construction and logistics	11
2.8 Track Systems Contract geographical boundaries	14
2.9 Testing and commissioning	16
2.10 Maintenance and technical support contracts	18
3 Description of the Works – Track Systems	20
3.1 Introduction	20
3.2 Track Systems Supply Contracts	22
3.3 Track Systems Contracts	25
3.4 Track systems/MWCC interfaces	27
4 Description of the Works – Overhead Catenary System	29
4.1 Introduction	29
4.2 System details	30
4.3 Logistics	32
4.4 OCS /MWCC interfaces	32
4.5 Maintenance and technical support contracts	32
5 Description of the Works – Tunnel and Lineside M&E Systems	34
5.1 Introduction	34
5.2 Tunnel ventilation systems	36
5.3 Tunnel cross-passage systems	37
5.4 Tunnel low voltage distribution and lighting	38
5.5 Other tunnel works	38
5.6 Open route LV distribution	40
5.7 Further items	41
5.8 Technical support contracts	41

6	Description of the Works – HV Traction and Non-Traction Power Systems	42
6.1	Introduction	42
6.2	Traction power system	44
6.3	HV non-traction power system	45
6.4	Interfaces and general requirements	47
6.5	Maintenance and technical support contracts	51
7	Description of the Works - Operational Telecommunications and Security	52
7.1	Introduction	52
7.2	Operational Telecommunications and Security scope	52
7.3	Data transmission network	53
7.4	Operational telephony system	54
7.5	Tunnel radio system	54
7.6	Telecommunication towers	55
7.7	Relocatable equipment buildings	56
7.8	Route wide security	56
7.9	GSM-R radio access network	57
7.10	Interface management responsibilities	58
7.11	System integration facility	59
7.12	Cabling and cable protection	60
7.13	Civil engineering works	60
7.14	Maintenance and technical support services	60
8	Description of the Works - Third Party Telecommunications	62
8.1	Introduction	62
8.2	HS2 service performance requirements	62
8.3	Third Party Telecommunications scope	63
8.4	Interfaces with other HS2 contracts	64
9	Description of the Works - Engineering Management System	65
9.1	Introduction	65
9.2	System scope	65
9.3	System integration	67
9.4	System development and testing	68
9.5	System integration facility	68
9.6	Interfaces with other contractors	69
9.7	Maintenance and technical support services	71
10	Description of the Works – CCS and TM	72
10.1	Introduction	72
10.2	HS2 operational requirements	73
10.3	CCS and TM scope	73
10.4	Signalling	74
10.5	Automatic Train Operation	74

10.6	Traffic management system	75
10.7	Possession management system	76
10.8	Weather monitoring system	76
10.9	Adhesion management system	77
10.10	Enterprise service bus	77
10.11	NICC remote tap in facility	77
10.12	System integration facility	78
10.13	Equipment at the NICC	78
10.14	Cabling and cable protection	79
10.15	Civil engineering works	79
10.16	Interfaces	79
10.17	Maintenance and technical support services	80
10.18	Compliance with legislation and standards	80
11	Description of the Works - Depot and NICC Contractor	81
11.1	Introduction	81
11.2	Washwood Heath site	83
11.3	Depot – general requirements	86
11.4	Track systems	86
11.5	OCS, Power and M&E Systems	87
11.6	Control systems	88
11.7	Other systems	88
11.8	Depot buildings	89
11.9	Other depot facilities	90
11.10	Network Integrated Control Centre	90
11.11	Maintenance and technical support contracts	91
	Appendix 1 Acronyms	92
	Appendix 2 Revision history	96
	List of figures	
	Figure 1- HS2 Route Map showing Phases One, 2a and 2b	3
	Figure 2 - Route schematic showing contract boundaries and access points	16
	Figure 3 - Washwood Heath Depot and NICC	85
	List of tables	
	Table 1 - Railway systems contracts	6
	Table 2 - Summary of rail connections and facilities	13
	Table 3 - Track Systems Contractors’ geographical areas and key data	15
	Table 4 - HS2 Ltd defined maintenance levels	18
	Table 5 - Track Systems Contracts key data (track km)	21

Table 6 - OCS Contract key data	29
Table 7 - Tunnel & Lineside M&E Systems Contract key data	35
Table 8 - HV Power Systems Contract key data	42
Table 9 - HS2 Station customer footfall (thousands /day)	62
Table 10 - CCS and TM Contract key data	72
Table 11 - Depot and NICC Contract key data	82

Preface

This Railway Systems Scope Document ‘Compendium Version’ describes the technical coverage, or scope, of each of the proposed Tier 1 design and build railway systems contracts. Sections 1 and 2 are applicable to all design and build contracts and should be read in conjunction with the contract-specific scope description in Sections 3 to 11. A list of acronyms is provided in Appendix 1 and a revision history in Appendix 2.

The table below provides the title, reference number and applicability of each contract. HS2 rail systems supply contracts are also included.

Table i - Railway systems contracts and scope compendium section references

HS2 Railway Systems Contracts	Description	Section
HRS13 = Track Urban	Phase One - Euston Station to Chiltern Tunnel (north portal) and Bromford Tunnel to Curzon Street Station (inclusive)	3
HRS14 = Track Open Route Central	Phase One - Chiltern Tunnel (north portal) to Long Itchington Wood Tunnel (south portal) plus Calvert IMD	3
HRS15 = Track Open Route North	Phase One - Long Itchington Wood Tunnel to Handsacre Junction and Phase 2a interface	3
HRS16 = Track Phase 2a	Phase 2a only	3
HRS07 = Pre-cast Slab Track System	Phases One and 2a – Supply contract only	3
HRS17 = Rail	Phases One and 2a – Supply contract only	3
HRS18 = S&C	Phase One and 2a – Supply contract only	3
HRS12 = Overhead Catenary Systems	Phases One and 2a – two separate contracts awarded to one Contractor.	4
HRS02 = Tunnel and Lineside M&E Systems	Phases One and 2a	5
HRS03 = HV Traction and Non-Traction Power Systems	Phases One and 2a - to be awarded with maintenance contract	6
HRS20 = Operational Telecommunications Systems	Phases One and 2a - to be awarded with Technical Support Contract (TSC)	7
HRS21 = Third Party Telecommunications	Phases One and 2a	8
HRS23 = Control, Command, Signalling and Traffic Management	Phases One and 2a, with option for Phase 2b Traffic Management - to be awarded with TSC	9
HRS 22 = Engineering Management Systems	Phases One and 2a - to be awarded with TSC	10
HRS06 = Washwood Heath Depot and Network Integrated Control Centre	Phase One	11

1 Introduction

- 1.1.1 The content of this document is subject to revision and expansion in the Works Information, to be included in the Contract, which will be issued to the shortlisted Applicants/Candidates with the Invitation to Tender (ITT). This Works Information will include a full description of the scope of each contract, the processes and procedures that High Speed 2 (HS2) Ltd wishes successful contractors to apply, together with a detailed set of system requirements.
- 1.1.2 HS2 Ltd reserves the right to make reasonable additions or amendments to the content of this Scope Document during the Railway Systems procurements. In particular, and without limitation, changes to the general obligations and constraints, or the scope of work, may occur when HS2 Ltd commences the formal tender stage.
- 1.1.3 HS2 Ltd does not offer any warranties, guarantees or assurances as to the accuracy or completeness of the information contained in this document and quantities or measurements are only intended to be indicative and for the guidance of potential Applicants/Candidates.

1.2 HS2

- 1.2.1 HS2 is the name given to the project or programme of works, comprising Phase One and Phase Two, which is further divided into Phase 2a and 2b, as illustrated in Figure 1.
- 1.2.2 Authority for construction of Phase One has been obtained through the High Speed Rail (London – West Midlands) Act 2017, which received royal assent on 23 February 2017.
- 1.2.3 Authority for construction of Phase 2a is contained in the High Speed Rail (West Midlands to Crewe) Bill, which is passing through the United Kingdom (UK) Parliament and is expected to receive royal assent in 2020.
- 1.2.4 The Secretary of State for Transport is developing proposals in relation to Phase 2b, in preparation for a hybrid Bill.
- 1.2.5 In each case, once royal assent is obtained, the HS2 legislation grants powers to build and maintain HS2 and its associated works. These powers include the acquisition of interests in the land, the ability to change rights of way and modify existing infrastructure. The powers also enable HS2 Ltd to make necessary changes to existing legislation in order to facilitate construction and operation of HS2.

1.3 HS2 Ltd

1.3.1 HS2 Ltd is the company responsible for developing and promoting the UK’s new high-speed rail network. It is funded by the UK government and sponsored by the Department for Transport.

1.3.2 HS2 Ltd is responsible for ensuring that the HS2 rail network is:

- designed, built and operated with the highest safety standards
- built and operated sustainably, responsibly and with respect for the communities, wildlife and places it affects
- reliable, seamless and easy to use for all passengers and well-integrated with existing transport systems

1.3.3 HS2 Ltd is committed to working with all our suppliers to build a skilled workforce that supports economic growth across the UK.

1.3.4 Further information will be included in the ITT concerning these commitments and how HS2 Ltd intends to work with its supply chain to fulfil them.

1.4 HS2 route description

1.4.1 This Scope Document relates to HS2 Phases One and 2a.

1.4.2 The Phase One route comprises approximately 220 km of predominantly double-track high-speed railway running north from Euston Station in London to a junction with the West Coast Main Line at Handsacre in Staffordshire, with a spur from Water Orton in Warwickshire to a terminus at Birmingham Curzon Street. It includes intermediate stations at Old Oak Common in London and Birmingham Interchange.

1.4.3 Phase One also includes a grade-separated junction (Delta Junction) to the east of Birmingham, with connections to facilitate the eastern leg of HS2 to Leeds (Phase 2b).

1.4.4 Phase 2a extends from Streethay Junction at Fradley, approximately 2.5 km north-west of Lichfield, to Crewe Junction. It comprises approximately 58 km of double track high-speed railway and includes two spurs south of Crewe that will allow trains to transfer between the HS2 and the West Coast Main Line, as well as provision for a further northern extension towards Manchester (Phase 2b).

Figure 1- HS2 Route Map showing Phases One, 2a and 2b



- 1.4.5 The Phase One route passes through three bored tunnels at its southern end: first Euston Tunnel (7.4 km long), then Northolt Tunnel (14.2 km long) and then Chiltern Tunnel (16.2 km long), all of which include combined ventilation and intervention shafts at intervals up to 3.3 km. On the Birmingham Spur there is a bored tunnel (Bromford) which is 5.86 km long which includes one combined ventilation and intervention shaft. There are 11 shafts across the Phase One route.
- 1.4.6 Along the Phase One route there are six cut-and-cover tunnels, including one which is a combination of cut-and-cover and bored tunnel (Long Itchington Wood). There are box-sections at Oak Common Station and Victoria Road, with the Northern Approaches to Euston comprising a combination of retained cutting and an enclosed cavern, all of which all vary in size and structure. On the Phase 2a sections, there are two bored tunnels at Whitmore and Madeley. Other short tunnels may be required along the route, subject to civil engineering design development.
- 1.4.7 Many of the HS2 tunnels are fitted with “porous portals” which are extensions to the tunnels and are required for the mitigation of micro-pressure waves instigated by the passing of high-speed trains.
- 1.4.8 There are approximately 47 underbridges, 148 overbridges and 58 viaducts on Phase One and 18 underbridges, 43 overbridges and 4 viaducts on Phase 2a.

- 1.4.9 There are two sets of track loops for use by passenger and maintenance trains on the Phase One route, approximately located at 56 km and 116 km points where London Euston Station is the origin at 0 km.
- 1.4.10 The HS2 infrastructure is designed for the operation of high-speed passenger rolling stock units, each of 200 metres in length. Two units can operate in formation such that the longest trains in normal operation are 400 metres in length. No provision is made for the operation of freight trains.
- 1.4.11 The HS2 operational requirements are:
- Maximum operational line speed of 360 kph with varying line speeds along the route
 - 18 trains per hour in both directions
 - Bi-directional operation at the maximum permissible line speed
- 1.4.12 Two types of rolling stock are planned for operation on HS2. ‘Captive’ trains will be designed for services that operate entirely on the new HS2 infrastructure. ‘Conventional Compatible’ trains will be designed to the same performance specification (journey times, etc) but will be compatible with the UK conventional rail network (CRN), to enable journeys to continue to destinations beyond the new infrastructure.
- 1.4.13 The Phase One Rolling Stock Maintenance Depot (RSMD) is at Washwood Heath in Birmingham, 3.5 km from Curzon Street station. It will initially be used to serve the first ‘Conventional Compatible’ HS2 fleet but will be designed to accommodate ‘Captive’ trains also. The site also houses the Network Integrated Control Centre (NICC), which will be used to control the railway infrastructure of HS2 Phases One, 2a and 2b.
- 1.4.14 There will be an HS2 infrastructure maintenance depot (IMD) at Calvert, (which lies approximately 33 km north of the Chiltern Tunnel) and an infrastructure maintenance base (IMB-R) at Stone on Phase 2a. The Stone IMB-R site is designed to enable conversion to an IMD to support Phase 2b infrastructure maintenance. There will also be an IMB-R at West Ruislip, just north of the Northolt Tunnel. All these bases will be rail connected.
- 1.4.15 The Calvert IMD site will initially be established as a construction railhead that utilises the final proposed layout for the IMD. As the usage of the railhead reduces over the course of the construction phase, the site will be converted into the permanent IMD by provision of associated buildings and infrastructure.

- 1.4.16 The Stone IMB-R site is designed to act as a construction railhead during the Phase 2a construction window in a similar way to that described at Calvert IMD. On completion of Phase 2a construction, the Stone site will be converted to an IMB-R with the ability to act as a light maintenance facility for on-track plant with provision of workshop buildings and associated infrastructure. The design of the Stone site will enable conversion to an IMD to support Phase 2b infrastructure maintenance.
- 1.4.17 The West Ruislip IMB-R will be a small-scale stabling siding for on-track plant to be cleaned and replenished with consumables. There will be no permanent buildings, welfare or other facilities at West Ruislip IMB-R.
- 1.4.18 There will be permanent connections with the CRN at Calvert, Handsacre Junction and Crewe.
- 1.4.19 The details of all of the permanent infrastructure arrangements for these facilities and their potential for use during the construction phase, will be set out in the Works Information.
- 1.4.20 The Phase One route has a bat mitigation structure at Sheep House Wood near to Calvert. This is a metal caged structure formed over both the HS2 and CRN lines.

1.5 Railway Systems Contractors and Others

- 1.5.1 The railway systems design and build contracts are referred to in this document as Railway Systems Contracts. In this Scope Document, we refer to ‘Others’ to mean other contractors with whom the Railway Systems Contractors will be working and sharing the site.
- 1.5.2 Table 1 below provides the title, reference number and applicability of each contract, including the key supply contracts.
- 1.5.3 In addition to the Railway Systems Contractors listed below, HS2 Ltd has appointed (or is appointing), other major suppliers and contractors:
- Phase One Enabling Works contractors (EWC)
 - Phase One Main Works Civil contractors (MWCCs)
 - Phase One Stations designers and contractors (Euston, Old Oak Common, Birmingham Interchange, Birmingham Curzon Street)
 - Delivery partner(s) for Phase Two
 - A rolling stock manufacturer and maintainer

1.5.4 HS2 Ltd is also appointing suppliers of common components or contractors for the provision of other services. Some of these may have important interfaces with the railway systems programme.

Table 1 - Railway systems contracts

HS2 Railway Systems Contracts	Scope
HRS13 = Track Urban	Phase One - Euston Station to Chiltern Tunnel (north portal) and Bromford Tunnel to Curzon Street Station (inclusive)
HRS14 = Track Open Route Central	Phase One - Chiltern Tunnel (north portal) to Long Itchington Wood Tunnel (south portal) plus Calvert IMD
HRS15 = Track Open Route North	Phase One - Long Itchington Wood Tunnel to Handsacre Junction and Phase 2a interface
HRS16 = Track Phase 2a	Phase 2a only
HRS07 = Pre-cast Slab Track System	Phases One and 2a – Supply contract only
HRS17 = Rail	Phases One and 2a – Supply contract only
HRS18 = Switches and Crossings (S&C) including rail expansion devices (REDs)	Phase One and 2a – Supply contract only
HRS12 = Overhead Catenary Systems (OCS)	Phases One and 2a – two separate contracts awarded to one Contractor.
HRS02 = Tunnel and Lineside Mechanical and Electrical (M&E) Systems	Phases One and 2a
HRS11 = Cross Passage Doors (CPD)	Phases One and 2a
HRS03 = High Voltage (HV) Traction and Non-Traction Power Systems	Phases One and 2a - to be awarded with maintenance contract
HRS20 = Operational Telecommunications Systems	Phases One and 2a - to be awarded with Technical Support Contract (TSC)
HRS21 = Third Party Telecommunications	Phases One and 2a
HRS23 = Control, Command, Signalling (CCS) and Traffic Management (TM)	Phases One and 2a, with option for Phase 2b Traffic Management - to be awarded with TSC
HRS22 = Engineering Management Systems (EMS)	Phases One and 2a - to be awarded with TSC
HRS06 = Washwood Heath Depot and Network Integrated Control Centre (NICC)	Phase One

2 Contractor’s general obligations

2.1 Introduction

- 2.1.1 This section sets out some of the general obligations in relation to systems integration, design, construction, testing and commissioning that will be defined further in the Works Information documents for the Railway Systems Contractors.
- 2.1.2 At all stages in the programme, Railway Systems Contractors will be expected to work collaboratively together, using the processes and procedures that will be set out in the Works Information, in order to ensure that the project delivers its strategic goals and benefits (to be included in the Contract).
- 2.1.3 Railway Systems Contractors will also be expected to engage, directly and indirectly, with a significant number of local stakeholders, including local authorities and communities, to ensure that their aspirations are considered in both the planning stage and the delivery of the works.
- 2.1.4 In most cases, HS2 Ltd, as Project Manager under the contract, will take the lead in relation to technical and scope management, systems integration, construction co-ordination and management of testing and commissioning. In some cases, HS2 Ltd will expect the Railway Systems Contractors to fulfil leading roles in relation to site co-ordination, leadership of certain technical interfaces, or leadership in collation of construction consent applications. In each case, the role of HS2 Ltd and the role of each of the Railway Systems Contractors will be defined in the Works Information which will be provided at the tender stage.

2.2 Human resources and contract administration

- 2.2.1 HS2 is a major programme of work and a nationally significant infrastructure investment, so HS2 Ltd expects all its contractors to support a number of strategic objectives in relation to the management of human resources. These include requirements in respect of skills, education and employment and in relation to equality, diversity and inclusion. HS2 Ltd expects contractors to work to high employment relations standards and to share its vision and values in respect of health and safety.
- 2.2.2 Because the programme of work is complex and includes many contracts, large and small, HS2 Ltd also expects contractors to adopt its established processes for contract administration and project controls. We also have certain software systems that we will expect contractors to adopt.

2.2.3 HS2 Ltd is establishing several initiatives that will help drive the construction and transport sectors forward. For example, in developing a culture of innovation and the adoption of technological solutions and offering support to small and medium-sized enterprises (SMEs). Details will be included in the Works Information.

2.3 Systems integration

2.3.1 HS2 is a major programme of work that includes complex engineering scope, apportioned between several contracts, managing different systems and sub-systems. This work must be brought together in the design, construction, testing and commissioning stages in order to achieve a safe, reliable, high-performance railway that operates trains at 360 km/h and can meet a demanding train service specification.

2.3.2 HS2 Ltd will act as Prime System Integrator to lead systems integration for the programme, working closely with suppliers, contractors and stakeholders to create an end-state railway that is safe, operable, maintainable, ready for revenue service.

2.3.3 As Prime Systems Integrator, HS2 Ltd will take overall responsibility for the integration of the railway system including the management of tools and processes that support delivery of this outcome. As part of this role, HS2 Ltd will manage the demonstration of system performance, reliability, availability, maintainability and safety. HS2 Ltd has also defined system architectures to support interface management and will be setting technical specifications.

2.3.4 The Railway Systems Contractors and their supply chain are expected to work closely with HS2 Ltd in support of this Integrator role and will be expected to have an understanding of their own role in these processes and to support the integration work for the overall benefit of the programme. They and their supply chains will be expected to fulfil one or more of three roles:

- Lead Systems Integrator: Nominated leader for the delivery of specific Integration aspects, e.g. requirements associated with capability or functionality of the Railway that coordinates all applicable contractors to achieve the fulfilment of specific Integration Requirements.
- Participating System Manufacturer/Supplier: Nominated to participate in developing specific Integration aspects, e.g. requirements associated with capability or functionality of the Railway.
- Provider of data/information: Nominated to provide data or information necessary for others to develop specific Integration aspects.

2.3.5 HS2 Ltd will require close technical collaboration and planning between all its contractors and suppliers, as well as between engineers, constructors and sub-contractors. Railway Systems Contractors are expected to consider this in the formulation of their teams at every stage in the project life-cycle, including during design, construction, testing and commissioning in order to achieve key integration milestones that will be used to measure the successful delivery of the programme. Further details will be set out in the Works Information.

2.4 Design, environmental requirements and consents

2.4.1 The Railway Systems Contractors will be responsible for design of the systems within their scope of work, in accordance with the requirements set out in Works Information. In some cases, this will include design of the works against system performance requirements and in other cases they will be required to complete the design based on a concept or scheme design that has been produced by HS2, undertaking validation if required.

2.4.2 Railway Systems Contractors will be expected to optimise their designs in order to meet HS2 Ltd’s performance, reliability, availability, maintainability and safety (PRAMS) requirements. They will also be required to comply with the European Union Commission Implementing Regulation (EU) 402/2013, which relates to a Common Safety Method (CSM) for risk evaluation and assessment, in addition to meeting all relevant UK legislation.

2.4.3 The design of any permanent buildings and infrastructure will need to be delivered in accordance with the HS2 design vision and all relevant HS2 design approach documents included with the Works Information. Contractors may also be required to achieve a Building Research Establishment Environmental Assessment Methodology (BREEAM) ‘Excellent’ rating for their designs.

2.4.4 The Railway Systems Contractors may be required to work with HS2 Ltd to obtain consents for design and construction of the works, including statutory planning consents and other consents required by the HS2 Act. Detail of the requirements and the processes that the contractors are expected to adopt will be set out in the Works Information.

2.4.5 Railway Systems Contractors may also be required to undertake design, installation and removal of temporary works or design, installation and commissioning of stages of the permanent works in order to provide the final configured operational railway. Details of proposed commissioning stages for implementation of Phase One and 2a will be set out in the Works Information.

2.4.6 HS2 Ltd is working with the UK Government and non-governmental bodies in relation to a range of practical measures aimed at greenhouse gas reduction. Each Railway Systems Contractor will be expected to work with HS2 Ltd and their own supply chains in order to minimise the carbon footprint of HS2 as far as practicable. This will include active consideration of carbon emissions at all stages of the programme: applying tools that assess the potential to reduce carbon through design, construction and operation, as well as using materials and design innovation to reduce embedded carbon in construction materials and carbon emissions from construction works. HS2 Ltd also welcomes design proposals that reduce the energy requirements of the scheme, maximise the energy-efficiency of operations, or which support the use of low carbon energy and carbon sequestration.

2.5 Design and Building Information Modelling (BIM)

2.5.1 The effective exchange of information between HS2 Ltd and its contractors is critical to the success of a programme of this scale and complexity. Each Railway Systems Contractor will be required to develop and support an interface with HS2 Ltd’s common data environment (CDE) for the deployment and full utilisation of BIM, to create and exchange designs, design information, as-built drawings and other asset information.

2.5.2 Further details of this interface and the requirements to support the use of a CDE will be set out in the Works Information.

2.6 Safety

2.6.1 Safety, respect, leadership and integrity are HS2 Ltd’s core values and our contractors are required to support these values.

2.6.2 The roles of Client and Principal Designer under the Construction (Design and Management) Regulations, 2015, will be undertaken by HS2 Ltd.

2.6.3 In some cases, Railway Systems Contractors will be required to fulfil the role of Principal Contractor (PC), as defined by these Regulations. They may also be expected to fulfil the roles of Contractor and Designer where appropriate. The following PC arrangements will be expected to apply:

- The Track Systems Contractor will be PC for the line of route within a geographical area, including all open route and tunnelled sections and the construction railheads.

- The HV Traction and Non-Traction Power Systems Contractor will be the PC for the Railway Systems compounds containing high voltage electrical power systems.
- The Tunnel and Lineside M&E Systems Contractor will be the PC for the shafts associated with tunnels, portal buildings and associated compounds.
- The Operational Telecommunications Contractor may be required to act as PC for remote radio compounds.
- The Control, Command, Signalling and Traffic Management Contractor may be required to act as PC for certain stages of the NICC systems installation or for remote locations.
- The WWH Depot and NICC Contractor will be the PC for the RSMD and for the NICC control centre.

2.6.4 Each PC will be responsible for provision of staff briefing, security and management of all their working areas and site compounds, including granting and controlling access by HS2 Ltd and Others. Detailed PC boundaries and arrangements will be included in the Works Information.

2.7 Construction and logistics

2.7.1 The Railway Systems Contractors will be required to manage all aspects of supply, delivery and logistics to support site installation and construction activities, followed by testing and commissioning, including provision of all personnel and equipment that are necessary to complete their scope of work in accordance with the requirements of the Works Information.

2.7.2 There are a number of important HS2 stakeholders and programme partners, including Department for Transport, Network Rail, Transport for London and East-West Rail, with whom HS2 Ltd has entered programme or contract-level agreements. All HS2 contractors are expected to collaborate with such stakeholders, under the direction and guidance of HS2 Ltd.

2.7.3 All Railway Systems Contractors may also be required to undertake specific responsibilities for community engagement, local security, logistics and materials handling or wider co-ordination, as required by the HS2 Act and as set out in the Works Information. In some cases, these will be led by the Track Contractors, or other appointed contractors. These obligations are in addition to responsibilities generally placed on Principal Contractors under the Construction (Design and Management) Regulations.

2.7.4 The MWCCs will hand over to the respective PCs a number of main or satellite construction compounds and logistics access points that have been identified by HS2

Ltd and strategically located along the route, including at tunnel shafts and portals. On the open route sections, these are at approximately 4-5 km intervals and will consist of suitable levelled ground on which the contractors will be expected to install site offices and welfare facilities, or equipment to support delivery of the works. Only a limited amount of space will be available in these compounds, so contractors are required to consider this when planning their logistics arrangements. In particular, car parking is expected to be very limited along the trace.

- 2.7.5 Track Systems Contractors install and manage construction railheads at locations that will be specified in the Works Information. The Track Systems Contractors will be required to design, install, operate and maintain these temporary construction railheads for their own use and the use of other Railway Systems Contractors. These sites have outline planning consent for use during construction and in some cases, authorisation for connection to the CRN has been established by HS2 Ltd.
- 2.7.6 All Railway Systems Contractors will be expected to work closely with HS2 Ltd, the Track Systems Contractors and Others to optimise the use of all the shared facilities.
- 2.7.7 Table 2 below is a provisional summary of these construction railheads, the permanent or temporary CRN connection arrangements and the associated facilities at each site.

Table 2 - Summary of rail connections and facilities

Track Systems Contract	Railhead Location	Rail Connection	Notes
Phase One Urban	West Ruislip IMB-R (maintenance siding)	Temporary connection to CRN	Limited area available for railhead for use by Urban Track Systems Contractor and Railway Systems Contractors. Conversion to permanent use included in Track System contract.
	Washwood Heath	Temporary connection to CRN	For use by Urban Track Systems Contractor only. The connection and siding are temporary. The siding will need to be built on the HS2 trace. Note that there is not any planned access to the WWH RSMD through this connection.
Phase One Open Route Central	Calvert IMD	Connection to main line available via East-West Rail	Permanent IMD area available for use by Open Route Central Track Systems Contractor and Railway Systems Contractors. Conversion to permanent use included in Track System contract.
Phase One Open Route North	Handsacre Junction	Connection to CRN	For use by Open Route North Track Systems Contractor and Railway Systems Contractors.
	Berkswell	Temporary connection to CRN	Temporary railhead for use by Open Route North Track Systems Contractor and Railway Systems Contractors.
Phase 2a Open Route	Crewe Junction	Connection to CRN	For use by Phase 2a Track Systems Contractor and Railway Systems Contractors.
	Stone IMB-R	Connection to CRN	Area available as railhead for use by Phase 2a Track Systems Contractor and Railway Systems Contractors. Conversion to permanent use included in Track System contract.

- 2.7.8 The Track Systems Contractors, or other Railway Systems Contractors and Suppliers, will be required to participate in the design, installation, testing and commissioning of works related to the CRN interfaces. For example, the Control, Command, Signalling (CCS) and Traffic Management (TM) Contractor will design signalling equipment controlled by the NICC, which may include equipment located on the CRN. HS2 Ltd’s On Network Works team will be responsible for all signalling equipment controlled by Network Rail, which may include equipment located on HS2 property and both teams will be responsible for testing and commissioning their respective elements.
- 2.7.9 Arrangements for the design and installation of primary cable containment will vary. In general, the Track Systems Contractors will be responsible along the open route and the M&E System Contractor will be responsible in tunnels. In each case, the layout and route capacity will be determined by HS2 Ltd. Secondary cable containment will be provided by the Railway Systems Contractors as specified in the Works Information.

2.8 Track Systems Contract geographical boundaries

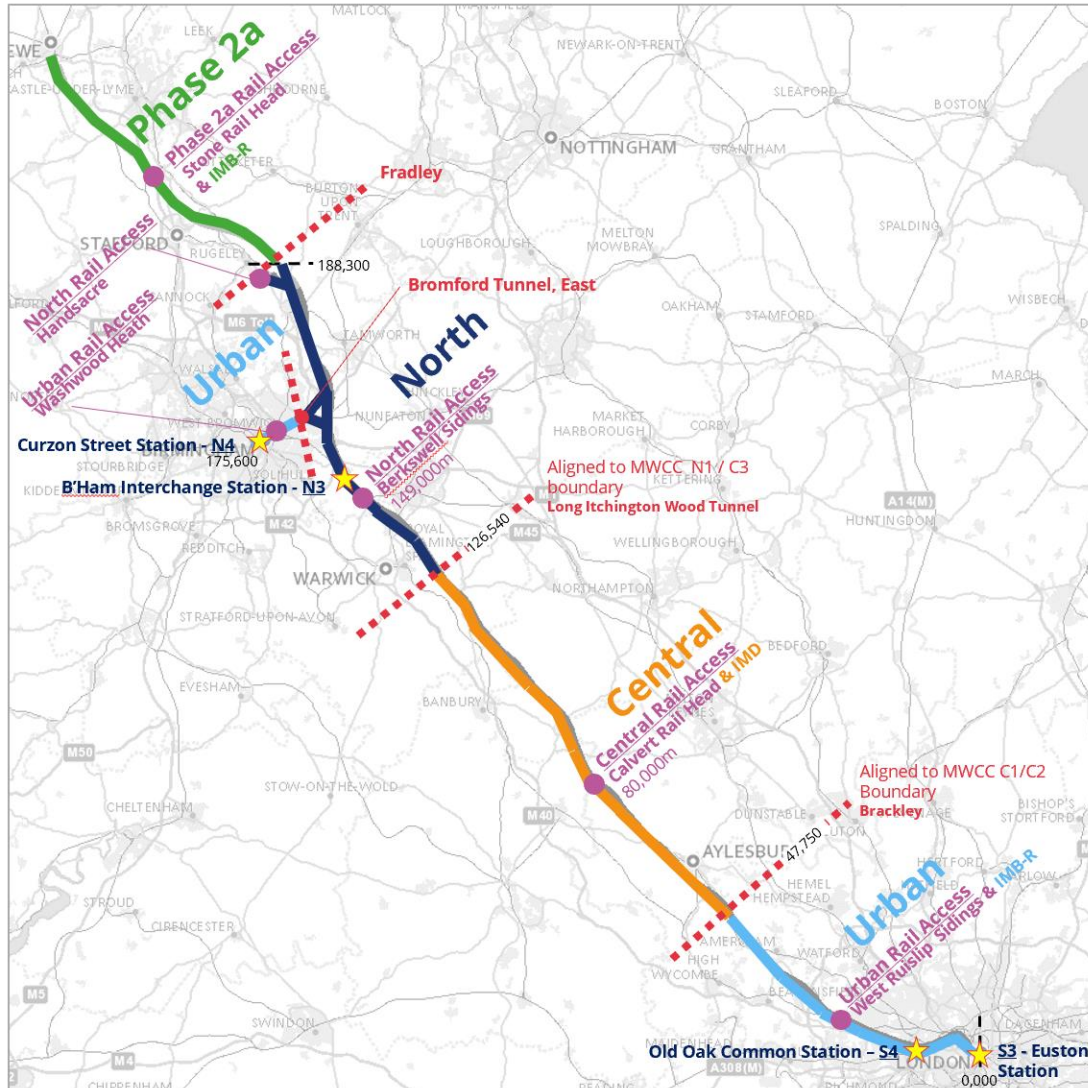
- 2.8.1 The Track Systems Contractors will provide important safety, logistics and co-ordination roles along the trace. A summary of the geographical areas of each of these Contractors, together with key data related to their areas, is included in Table 3 below.

Table 3 - Track Systems Contractors’ geographical areas and key data

Track Systems Contract	Geographical Description	Characteristics
Urban	Phase One route from Euston buffer stops to the MWCC contract boundary between C1 and C2. Delta Junction to Birmingham Curzon Street. Interface to WWH Depot. West Ruislip IMB-R.	0.0 to 47.75km and 164.5 km to 175.6 km. Approximately 72 units of S&C. 24 platform tracks (11 at Euston, 6 at Old Oak Common, 7 at Birmingham Curzon Street). Bored tunnels at Euston (7.4 km), Northolt (14.2 km), Chiltern (16.2 km), Bromford (5.8 km). Box sections at Old Oak Common station, Victoria Road and the Northern Approaches to Euston. Max speed 320 km/h.
Open Route Central	Phase One route from MWCC C1/C2 to C3/N1 boundary including Calvert IMD and permanent connection to the CRN (East-West Rail).	47.75 km to 126.54 km. Approximately 22 units of S&C. Main line track loops. 3 short tunnels (Chipping Warden, Greatworth and Wendover). Max speed 360 km/h
Open Route North	Phase One route from MWCC C3/N1 boundary to start of the Birmingham spur (West of Delta Junction), Phase 2a boundary and permanent connection to the CRN at Handsacre Junction.	126.54 km to 188.3 km and 167.5 km. Approximately 42 units of S&C. 4 platform tracks at Birmingham Interchange. 2 short tunnels (Burton Green, Long Itchington Wood). Max speed 360 km/h.
Phase 2a	Phase 2a route including Stone IMB-R and permanent connection to the CRN at Crewe Junction.	188.3 km to 245.9 km. Approximately 23 units of S&C. 2 short tunnels (Whitmore and Madeley). Max speed 360 km/h.

2.8.2 A schematic overview of the route, showing the geographical split between Track System Contracts, rail access and railheads for use during the construction phase, is shown in Figure 2 below.

Figure 2 - Route schematic showing contract boundaries and access points



2.9 Testing and commissioning

- 2.9.1 The Railway Systems Contractors will be responsible for carrying out the factory testing, site testing and commissioning of their own systems or sub-systems in accordance with HS2 Ltd’s testing and commissioning (T&C) procedures. These may include product and system-level testing, activities relating to static verification testing, site acceptance testing and static integration testing.
- 2.9.2 Where specified in the Works Information, Railway Systems Contractors will be required to provide an off-site testing facility for the purpose of software and hardware validation, integration testing, and validation of changes, provided and maintained until completion of the works.

- 2.9.3 The Railway Systems Contractors and Suppliers will also be required to undertake work during static integration and dynamic integration testing, to support the T&C co-ordination work of HS2 Ltd as Prime Systems Integrator.
- 2.9.4 HS2 Ltd will provide a System Integration Facility (SIF) to allow a number of command, control and communication systems to be proven in an off-line environment, prior to testing and commissioning, and to support the integration of systems during their development and delivery. The Railway Systems Contractors will be expected to make use of the SIF where appropriate to provide early demonstration of successful integration and interfacing of control and supervision systems within their scope.
- 2.9.5 After contract completion or sectional completion, the SIF will also be used to support ongoing maintenance including fault finding, simulation of failures and the testing of both hardware and software system upgrades.
- 2.9.6 The Railway Systems Contractors may be required to provide and operate specialist test equipment, including rail-mounted plant or specialist trains as defined in the Works Information.
- 2.9.7 HS2 Ltd may require early access to the works before sectional completion or completion, in accordance with the Conditions of Contract and as set out in the Works Information. The Railway Systems Contractors may be required to provide inspection and maintenance services of such assets before sectional completion or completion.
- 2.9.8 The Railway Systems Contractors will be required to produce drawings, design data and training in order to enable HS2 Ltd to operate, maintain, modify and develop the works and to operate and maintain the railway. There will also be requirements for provision of equipment, spares, health and safety information and operations and maintenance (O&M) manuals.
- 2.9.9 The Railway Systems Contractors will also be required to provide professional support to HS2 Ltd as Infrastructure Manager during trial operations in order to secure successful internal and external approvals that are necessary in order to bring trains into service.
- 2.9.10 The London Euston station build is currently being planned as a staged approach with additional platforms being constructed later. Details of this will be confirmed in the Works Information.

2.10 Maintenance and technical support contracts

2.10.1 In certain cases, HS2 Ltd may require Railway Systems Contractors to undertake technical support, or install system upgrades, undertake asset inspection or maintenance after completion or sectional completion.

2.10.2 The Railway Systems Contractors are expected to support the following maintenance principles:

- Provide predictive and preventive maintenance tools to support safe and sustainable HS2 infrastructure that meets customers’ expectations and achieves HS2’s commitment to Whole Life Value for Money (WLVfM) and Performance, Availability, Reliability, Maintainability and Safety (PRAMS) targets.
- Provide an innovative approach to existing railway data management, processing and analysis to support intelligent asset management.
- Offer in-built diagnostics with remote access and reporting.

2.10.3 HS2 Ltd adopts a standard set of defined maintenance levels, shown in Table 4 below.

Table 4 - HS2 Ltd defined maintenance levels

Maintenance Level	Description
Level 1	Non-service affecting works with a limited number of competences.
Level 2	Maintenance team activity, involving tools and equipment. Level 2 maintenance work may require a track possession or degraded mode of operation.
Level 3	Controlled repair by in-house technicians or original equipment manufacturer (OEM) intervention. High level of competence required, including handing assets back into operational service.
Level 4	Heavy replacements and renewal work. Significant impact on the availability of the infrastructure, including handing assets/systems back into operational service.
Rapid response	Rapid response actions required to address time-critical maintenance that is necessary to prevent or mitigate the extent of a service affecting failure, or to address a non-service affecting fault that has the potential to become service affecting. Cover must be available 24/7.

2.10.4 These services will be the subject of parallel contractual arrangements, (Maintenance Contracts or Technical Support Contracts) and are set out in the relevant sections of this Scope Description.

- 2.10.5 In some cases, the procurement of maintenance or technical support will be undertaken after the award of Design and Build contracts but with original equipment manufacturers or specialist suppliers. HS2 Ltd will work with the Railway Systems Contractors to procure these future services.

3 Description of the Works – Track Systems

3.1 Introduction

- 3.1.1 There will be four geographical Track Systems Contracts, known as Urban, Open Route Central, Open Route North and Phase 2a.
- 3.1.2 The successful Track Systems Contractors will be responsible for the design, construction, testing and commissioning of all plain line track, switches and crossings (S&C), rail expansion devices (REDs), track drainage and open route primary cable containment.
- 3.1.3 The Track Systems Contractors will be required to work with three significant supply contracts covering Phases One and 2a, for the precast slab track system, long-welded rail and S&C. These supply contracts are described in Section 3.2.
- 3.1.4 The Track Systems Contractor’s scope of work at Calvert IMD includes the track, signalling, train control, communications systems and buildings for that site. Track and buildings are also to be provided at Stone IMB-R. Hard-standing and utilities will be required at West Ruislip IMB-R. These sites (as well as other sites) are to be used as railheads under the supervision of the track contractor during construction and then later converted into their end-state condition. Further detail of the permanent system requirements at these maintenance facilities will be included in the Works information.
- 3.1.5 The track systems within the RSMD at Washwood Heath (Birmingham) do not form part of any track contract or related supply contract but will be included in the scope of the Depot and NICC Contract.
- 3.1.6 Design, construction, testing and commissioning of permanent or temporary connections to the CRN will not be included in the scope of the Track Systems Contracts.
- 3.1.7 The Table below provides an indication of the scope of work and key data for each of the Track Systems Contracts.

Table 5 - Track Systems Contracts key data (track km)

	Urban 0k000 to 47k750 and 164k500 to 175k650	Open Route Central 47k750 to 126k540	Open Route North 126k540 to 189k400 and 164k500	Phase 2a 188k291 to 245k950
Resilient cast <i>in situ</i> slab track	63 km			
Cast <i>in situ</i> slab track (non-resilient)	38 km (33 km Chiltern Tunnel – optional pre-cast)			5 km (Whitmore Heath Tunnel)
Standard pre-cast concrete slab track	21 km	159 km	176 km	119 km
Ballasted Track			12 km	
Mainline S&C units	75	22	42	23
Track drainage Infill	4 km	81 km	93 km	72 km
Cable containment (Troughing)	36 km	393 km	324 km	314 km
REDs	18	18	18	23
Other scope not included in figures above	West Ruislip IMB-R	Calvert IMD	Berkswell temporary railhead	Stone IMB-R

3.2 Track Systems Supply Contracts

3.2.1 The following supply contracts will be awarded by HS2 Ltd for Phase One and 2a:

- Precast slab track system
- Rail
- S&C and REDs

3.2.2 The Invitation to Tender will include further details of the scope of each of these contracts and the commercial relationships between the Track Systems Contractors and these suppliers.

Precast Slab Track System

3.2.3 HS2 Ltd has conducted an advanced procurement to identify and appoint a supplier of the pre-cast slab track and related professional services. This Precast Slab Track System contract is based on a two stage approach:

- During the first stage, the supplier will be in contract with HS2 Ltd to develop a design, including rail fastenings, of a track slab solution that meets HS2 Ltd’s technical requirements.
- During the second stage, each Track Systems Contractor will be required to enter a contract with this supplier, to undertake the manufacture and supply of the pre-cast track slabs to the previously accepted design.

3.2.4 The Track Systems Contractors will be required to work with HS2 Ltd to integrate the pre-cast concrete slab track system design that has been undertaken by the Precast Concrete Slab Track System supplier into the Works.

3.2.5 Under the terms of this supply contract, the supplier will provide the Track Systems Contractors with the following support services:

- Quality control and assurance throughout the manufacturing and installation process.
- Implementation of a slab identification and maintenance traceability.
- Development of the design through to Approved for Construction (AFC).
- Assistance in resolving technical queries.
- Provision of a detailed production schedule for the manufacture of the pre-cast track slab units.
- Manufacture and supply of all the required pre-cast slab track units.

3.2.6 The supply contract will contain an option for the supplier to undertake the logistics management and delivery of track slabs to the Track Systems Contractor’s nominated nodal delivery point, the exact location of which will be agreed with HS2 Ltd.

Rail

3.2.7 HS2 Ltd will undertake the procurement of main line long-welded rail (LWR) under the terms of a separate Phase One and 2a Rail supply contract, so that rail can be provided to the Track Systems Contractors for incorporation into the Works.

3.2.8 The Track Systems Contractors will be expected to provide rail for the IMB-Rs and the IMD.

3.2.9 For the main line tracks, long-welded rails will be CEN 60 (Eurocode BS EN 13674-1) profile, standard grade steel, with a minimum length of 108 m between rail ends, welded by an approved ‘solid phase’ welding technique such as flash butt welding. HS2 Ltd is working on the assumption that the supplied rail strings will be ≥ 216 m long. The Track Systems Contractors will provide HS2 Ltd with their anticipated rail quantities and delivery requirements to manage the timely delivery of the LWR in support of the construction schedule.

3.2.10 The rail supplier will be responsible for product assurance and compliance with the relevant HS2 standards.

3.2.11 Under the terms of this rail supply contract, HS2 Ltd will arrange for the rail to be delivered to nodal delivery points identified by the Track Systems Contractors (i.e. to an agreed railhead or a connection with the CRN). The Track Systems Contractors will arrange onward delivery to the site of work.

3.2.12 The Track Systems Contractors will be required to take receipt of the rail, manage logistics at the railheads and convey the rail to site, where it will be installed and joined using a welding method in accordance with HS2 standards.

S&C and REDs

3.2.13 HS2 Ltd will conduct a separate procurement to identify and appoint a supplier of the mainline S&C and REDs and related professional services. This contract will be based on a two stage approach:

- During the first stage, the supplier will be in contract with HS2 Ltd to develop a design that meets HS2 Ltd’s technical requirements.

- During the second stage, each Track Systems Contractor will be required to enter a contract with the supplier, to develop the site-specific details of the S&C, manufacture units, undertake quality assurance and deliver units to agreed locations for incorporation into the Works.

- 3.2.14 HS2 Ltd defines high-speed S&C units as those with a through line speed between 160 km/h - 400 km/h, with a range of diverging speeds (according to the turnout type) of 80 km/h - 230 km/h. All high-speed S&C units are to a transitional geometric design with swing-nose crossings. Where the diverging speed is >100 km/h (regardless of main line speed), high-speed S&C will be specified.
- 3.2.15 Where the diverging speed is ≤ 100 km/h, usually at station throats, S&C may be of a circular geometrical design (UIC) and may have fixed-nose crossings.
- 3.2.16 Where traffic volumes dictate, swing-nose crossings may be specified in preference to fixed-nose crossings.
- 3.2.17 The S&C units, including rails, fastenings, bearers/blocks, points operating equipment, detection and controlling systems, together with points heating elements and condition monitoring, will be supplied to the Track Systems Contractors, in accordance with the terms of the second stage contract. The Track Systems Contractor will be responsible for installation of the S&C layout and the testing and commissioning of the S&C units.
- 3.2.18 The S&C supplier will also provide and install the drives/motors/machines and associated equipment, interfacing with the lineside controllers which will be supplied, installed and commissioned by the CCS and TM Contractor. The Track Systems Contractors will be required to take responsibility for installation of all S&C equipment.
- 3.2.19 The S&C supplier will also provide heating elements as an integral part of the S&C system, for installation by the Track Systems Contractor. The Tunnel and Lineside M&E Systems Contractor will provide power and trackside transformers (with flying leads on 110 V cables) that connect to the heating elements. They will also provide the control function and sensors to enable the functioning of the points heating equipment. The Track Systems Contractor will be responsible for fitting the points heating elements on the rail.
- 3.2.20 The Track Systems Contractors will be required to provide and install S&C in the IMB-Rs and the IMD.

3.2.21 The Track Systems Contractors will undertake all work necessary to complete the installation of S&C in order to meet the HS2 Ltd performance requirements, as defined in the relevant technical standards, working closely with HS2 Ltd as Prime Systems Integrator in order to complete testing and commissioning.

3.2.22 The same supply contract will also be used for provision of REDs, which will be required on viaducts and bridges with large expansion lengths. The Track Systems Contractors will be required to work with HS2 Ltd and Others to determine the location of these devices.

3.3 Track Systems Contracts

3.3.1 Four track form types have been selected by HS2 Ltd to meet the speed and future tonnage requirements of the line.

- Standard pre-cast concrete slab track
- Cast in situ slab track
- Resilient in situ slab track
- Ballasted track

3.3.2 Specific locations for each track form and details of design options, will be set out in the Invitation to Tender.

3.3.3 The line speed along the route will vary, but the maximum operating speed for passenger trains will be 360 km/h.

3.3.4 The application of vertical, lateral and longitudinal design loading shall be in accordance with Eurocode EN 1991. Service loading from passenger trains is expected to reach a maximum of 17 tonnes axle load under normal operational conditions. The maximum cumulative loading for Phase One infrastructure, expressed as million gross tonnes per annum (MGTPA), will be 41 MGTPA for initial services, rising to 63 MGTPA once the full train service is implemented. Further details of these requirements will be provided in the Works Information.

3.3.5 HS2 Ltd will retain responsibility of the Project Master Alignment (PMA) which specifies the route wide alignment for the operational railway. The PMA defines the contiguous horizontal track centre-line, elevation and cant. HS2 Ltd will provide this alignment information to the Track Systems Contractor for incorporation into the detailed alignment design and track system design. The as-built track alignment and any subsequent adjustment until the works are taken over by the Employer will be the responsibility of the Track Systems Contractors.

- 3.3.6 The Track Systems Contractors will work with HS2 Ltd and their designers to achieve the design objectives of each track system. This includes the route-wide integration of HS2 acoustic design requirements and optimisation of material usage in respect to environmental impacts, including consideration of HS2 carbon lifecycle objectives.
- 3.3.7 Pre-cast concrete slab track will be installed in the open route section of Phase One and 2a with the option to install this form over other discrete lengths. Chiltern Tunnel is classified as standard pre-cast concrete slab track but will be subject to design development by HS2 Ltd, following the appointment of the Precast Slab Track System supplier.
- 3.3.8 The Track Systems Contractors will be required to assure the design and supply of *cast in situ* slab track, including the track fastening system, within their overall design responsibility. This will include vertical and horizontal rail adjustment capability in line with HS2 technical standards and using design solutions endorsed by HS2 Ltd. The fastening system will be required to be a proven design for high-speed railways and to conform to European Standards and HS2 Technical Standards.
- 3.3.9 Resilient *in situ* slab track will be required by HS2 Ltd in certain specified tunnel and station areas. This track is necessary to meet HS2 ground-borne noise and vibration performance requirements, (including in Euston, Northolt and Bromford Tunnels). This track-form typically utilises booted blocks or booted bearers.
- 3.3.10 HS2 Ltd will provide the input parameters for the track system design to be undertaken by the Urban Track Systems Contractor that will enable the design to meet or exceed the acoustic performance requirements.
- 3.3.11 There will also be short sections of ballasted track in the transition to the connections with the CRN, within the IMB-R at Stone and IMD at Calvert.
- 3.3.12 The Track Systems Contractor will be responsible for the design and installation of primary cable containment along the open route. The Tunnel and Lineside M&E System Contractor will be responsible for the design and installation of primary cable containment in tunnels. In each case, the layout and capacity will be agreed with HS2 Ltd. Secondary cable containment, diverging from the primary cable containment, will be designed and installed by the appropriate Railway Systems Contractors, as specified in the Works Information.
- 3.3.13 The Track Systems Contractor may be required to drill rails in plain line and S&C in order to fix bonds and cable connections that are required by other Rail Systems Contractors.

3.3.14 The Track Systems Contractor will also be responsible for:

- Installation of the Buried Earth Conductor (BEC). The BEC will be provided by the Tunnel and Lineside M&E System Contractor. This cable will be installed beneath the primary cable containment.
- Installation of acoustic mitigation, including low-level noise barriers, or noise absorption matting where required to reduce wheel/rail contact noise known as rolling contact noise.

3.3.15 The Track Systems Contractors may also be responsible for design of minor civil engineering works that are required to complete the track system.

3.4 Track systems/MWCC interfaces

3.4.1 The MWCC will complete a track formation layer, generally known as the frost protection layer (FPL) in the open route, that will support the designated track form.

3.4.2 The formation will be subject to performance requirements (defined in terms of tolerance, load-bearing, settlement rate, etc), to be met by the MWCC and subject to acceptance by HS2 Ltd prior to handover to the Track Systems Contractors.

3.4.3 The Track Systems Contractors will also be expected to work closely with HS2 Ltd’s specialist monitoring and technical support contractors, including geotechnical advisors, who will be independently assessing formation settlement and heave by monitoring and using prediction tools, which will support decisions to commence track installation.

3.4.4 The Track Systems Contractors will also be required to undertake re-profiling and secondary compaction of the FPL prior to commencement of track installation activities.

3.4.5 In open route pre-cast concrete slab track sections, the re-profiled FPL will form a base on which the Track Systems Contractors will lay an *in situ* concrete hydraulically-bound layer (HBL), before installation and grouting of the pre-cast concrete slabs. The design and technical requirements for this HBL layer will form part of the pre-cast concrete slab track system design, provided to the Track Systems Contractors by HS2 Ltd.

3.4.6 The Track Systems Contractors will also be responsible for design and installation of an impermeable layer to span the interval between two or more tracks in the open route. This impermeable layer will convey water to cross-drains or longitudinal trackside drainage provided by the MWCC. Detailing of the impermeable layer to

integrate with the drainage catch pits provided by the MWCC will be required in curved track sections.

- 3.4.7 In tunnels and any other areas of cast *in situ* slab track, including all areas of S&C, the MWCC will complete the first stage concrete layer including any walkways or upstands either side of the track. The Track Systems Contractors will be responsible for the design and installation of a suitable concrete bearing layer, cast *in situ* to support any pre-cast concrete elements in the track.
- 3.4.8 In areas of cast *in situ* slab track, including all areas of S&C, the Track Systems Contractor will be responsible for design and installation of any surface detailing required to convey water to the main drainage. In bored tunnels, the main drainage will be sited on the tunnel invert, encased in the first stage concrete laid by the MWCC and connected to the drainage system.
- 3.4.9 The MWCC will incorporate walkways and/or vertical upstands on either side of the track in tunnels and on viaducts for emergency evacuation and maintenance access.

4 Description of the Works – Overhead Catenary System

4.1 Introduction

- 4.1.1 There will be two separate OCS contracts, one for Phase One and one for Phase 2a, awarded to the same Contractor.
- 4.1.2 The Overhead Catenary System Contractor will be responsible for design, supply, manufacture, installation, testing and commissioning of the OCS systems in open route, stations and tunnels for HS2 Phase One and Phase 2a.
- 4.1.3 In this document, Overhead Catenary System Contractor is abbreviated to OCS Contractor.
- 4.1.4 Table 6 below contains indicative key data related to the OCS contracts in open route for Phase One and Phase 2a. For details of tunnels refer to Table 3.

Table 6 - OCS Contract key data

OCS Contracts	Key Data
Contract 1 Phase One	<p>469 track km, including 58 viaducts, 47 underbridges, 148 overbridges and 115 culverts.</p> <p>Six passing / maintenance loops/sidings and four complex track junctions.</p> <p>131 point ends, including 99 high-speed turnouts (between 130 km/h and 230 km/h), 32 low/medium speed turnouts (up to and including 100 km/h), 5 trap points or switch diamonds.</p> <p>Approximately 400 wire runs</p>
Contract 2 Phase 2a	<p>120 track km, including 18 underbridges, 43 overbridges, 4 viaducts, 1 retained cutting and 46 culverts.</p> <p>24 point ends (130 km/h), 2 high-speed turnouts (230 km/h)</p> <p>Approximately 100 wire runs.</p>

4.2 System details

- 4.2.1 An advance contract for the Phase One and 2a OCS System and Basic Design has been placed by HS2 Ltd. This design has been developed to support HS2's Phase One and 2a high-speed electric train operations and will deliver 25 kV AC nominal voltage to the train pantograph(s).
- 4.2.2 The output from this contract will be a 360 km/h TSI-compliant OCS Basic Design range, including a system known as V360-TSI for use up to 360 km/h and a reduced-tension variant known as V360-14/14 for use up to 230 km/h.
- 4.2.3 HS2 Ltd will mandate the use of this V360 basic design range for all HS2 main line OCS applications. Details of these designs will be included in the Works Information.
- 4.2.4 The design will comprise all the constituent longitudinal electrical conductors, including auto-transformer feeder wire/cables, earth wire/cables and any supplementary parallel reinforcing feeder wire/cable that may be necessary to form the on-track element of the electrification system.
- 4.2.5 The V360 main conductors and general technical characteristics will be as follows:
- The design tension of the contact and catenary wires will be 27.5 kN and 14 kN respectively for the V360-TSI design.
 - The design tension of both contact and catenary wires will be 14 kN for the V360-14/14 reduced-tension variant.
 - The contact wire will be specified as copper-tin alloy conductor, which has a 150 mm² cross-sectional area.
 - The catenary wire will be specified as 65 mm² cross-sectional area bronze cable.
 - The droppers will be specified as bronze cable, which has a 12 mm² cross-sectional area and complies with NF C34-110-2.
 - System encumbrance will be 1.40 m.
 - The contact wire will be pre-sagged in each span, with the amount of sag required calculated as 1/2000 of the span length, measured at mid span.
 - The contact wire will generally be fixed at a height of 5.120 m (above rail level measured at the catenary mast support and registration assembly) throughout the route, except at the interface with Network Rail where it may be graded to the existing system height.
 - The system design will not contain head-span or stitch-wire arrangements.
- 4.2.6 The OCS Contractor will be responsible for application of this design and specification to the detailed design of the OCS, including production of the OCS allocation design.

- 4.2.7 The OCS Contractor will be responsible for fabrication, installation, testing and commissioning of all components of the system, including, but not be limited to the following:
- mast and portal foundations
 - tunnel drilling and attachments
 - main steelwork
 - small parts steel (SPS)
 - earthing and bonding for the OCS
 - support and registration equipment
 - in-span equipment
 - wiring (including aerial earth and feeders) and in-span equipment
 - switches and disconnectors
 - electrification signage
 - stores and fabrication facilities for construction operations
- 4.2.8 Voltage transformers will be designed and supplied by the HV Power Systems Contractor and the OCS Contractor, depending on location and systems architecture, but installed and commissioned by the OCS Contractor.
- 4.2.9 HS2 Ltd will be responsible for the master alignment design, providing information to the Track Systems Contractors and the OCS Contractor for incorporation into their detailed designs.
- 4.2.10 The OCS Contractor will be required to work closely with HS2 Ltd, the Rail Systems Contractors and Others to integrate the design, construction, testing and commissioning of the OCS with the other rail systems, civil engineering and stations.
- 4.2.11 Three trackform designs will be developed by HS2 Ltd to meet the speed and future tonnage requirements of the line. The trackform designs will include:
- standard pre-cast concrete slab track
 - cast in situ standard track
 - resilient in situ slab track
- 4.2.12 There will also be a section of approximately 12 km of ballasted track at the connections to the CRN.
- 4.2.13 The HS2 infrastructure maintenance facilities, at Calvert IMD and Stone IMB-R will not be electrified.

- 4.2.14 The overhead catenary system at the HS2 Rolling Stock Maintenance Depot at Washwood Heath (Birmingham) will not be included in the scope of the OCS Contract. This system will be designed, supplied, manufactured, installed, tested and commissioned by the Depot and NICC Contractor.
- 4.2.15 The HV Systems SCADA server located at the NICC will be designed and installed by the HV Power Systems Contractor.
- 4.2.16 SCADA and power connections to any motorised switches or disconnectors will be provided by Others.

4.3 Logistics

- 4.3.1 The OCS Contractor will be expected to work closely with HS2 Ltd, the Track Systems Contractors and other contractors to develop an integrated construction and logistics programme. Subject to this programme, the Track Systems Contractors may provide logistics support and engineering trains to the OCS Contractor for delivery of materials and cabling. The OCS Contractor will provide all necessary information to support this approach, provide site supervision and remain responsible for material supply and installation.

4.4 OCS /MWCC interfaces

- 4.4.1 The Phase One and 2a civil engineering contractors will provide a level site where the ground has been remediated for use as a formation for construction of the OCS foundations. Bulk earthworks or contaminated land remediation are not expected to be required as part of the OCS scope.
- 4.4.2 Viaduct foundation attachments for the OCS will be provided by the Phase One and 2a civil engineering contractors.
- 4.4.3 The OCS Contractor will be required to install the OCS fixings in bored and cut and cover tunnels.
- 4.4.4 Further details of interfaces between the OCS Contractor and the civil engineering contractors will be included in the Works Information.

4.5 Maintenance and technical support contracts

- 4.5.1 The OCS Contractor will be required to undertake any required maintenance of all equipment provided within this package between the date of installation and take-over of the Works by the Employer.

- 4.5.2 The OCS Contractor will not be required to undertake any maintenance of the works after take-over of the Works by the Employer. The assets are to be maintained by HS2 Ltd.
- 4.5.3 The OCS Contractor may be required to provide professional technical support to the Employer throughout trial operations.
- 4.5.4 The OCS Contractor may also be required to support temporary operation of the OCS system, including making the system available during the installation and testing of HS2 rolling stock and other railway systems.

5 Description of the Works – Tunnel and Lineside M&E Systems

5.1 Introduction

- 5.1.1 The Tunnel and Lineside M&E Systems Contractor will be responsible for design, supply, manufacture, installation, testing and commissioning of the M&E systems in open route (remote from the rail systems compounds) and tunnels, including tunnel and portal shafts, portal headhouses and cross-passages.
- 5.1.2 In this document, Tunnel and Lineside M&E Systems Contractor is abbreviated to M&E Systems Contractor.
- 5.1.3 In shafts and portal buildings, the MWCC will be responsible for the building services provision and the M&E Systems Contractor’s scope will principally be associated with tunnel services, such as tunnel ventilation and electrical services that serve the tunnels.
- 5.1.4 The M&E Systems will be designed for both permanent and construction use. The details of each use case, with requirements for design, performance characteristics and responsibilities for inspection, operation and maintenance, will be set out in the Works Information. The M&E Systems includes the early use and subsequent refurbishment of the permanent ventilation fans for use during railway systems tunnel fit out works and the provision of supplementary temporary jet fans (approximately 85, or fewer if permanent jet fans are installed and refurbished).
- 5.1.5 HS2 Ltd will provide Tenderers with sufficient design in order to develop a cost estimate or Target Cost at tender stage.
- 5.1.6 For example, for the permanent works, HS2 Ltd will specify the number of ventilation fans, with requirements for ventilation capacity and air flow rates, so that HS2 Ltd retains the responsibility for calculation of the air flow rate in the tunnels. HS2 Ltd will provide technical specifications for ventilation sub-equipment to be designed by the successful contractor.
- 5.1.7 For the construction ventilation system, it will be the responsibility of the M&E Systems Contractor to calculate the fan requirements.
- 5.1.8 For other systems downstream of the low voltage distribution point (LVDP), such as lighting and points heating, performance specifications will be provided and the M&E

Systems Contractor will be expected to apply nationally-recognised engineering specifications for materials and workmanship.

5.1.9 The mechanical and electrical systems at the RSMD at Washwood Heath and the IMD at Calvert are not included in the scope for the M&E Systems Contractor, although the installation of M&E control systems at the NICC will be included in this contract.

5.1.10 Table 7 below contains indicative key data related to the M&E Systems Contract.

Table 7 - Tunnel & Lineside M&E Systems Contract key data

M&E Systems Contract	Key Data
Ventilation Systems Permanent and temporary tunnel ventilation systems using reversible axial or jet fans in approximately 51 kms of tunnels.	Bored tunnels at Euston (7.4 km), Northolt (14.2 km), Chiltern (16.2 km), Bromford (5.8 km), a proportion of Long Itchington (1 km), Whitmore and Madeley. Matière arch tunnels at Chipping Warden, Greatworth and Wendover. Short 'cut and cover' tunnels at Burton Green and a proportion of Long Itchington Wood. Box sections at Old Oak Common Station, Victoria Road and the Northern Approaches to Euston. 10 combined ventilation and intervention shafts and one intervention-only shaft across Phase One and Phase 2a. Copthall single cell cut and cover tunnel (naturally ventilated but requiring tunnel services)
Scope Elements	Approximate Quantities
Axial fans and associated equipment	22 fans
Jet fans and associated equipment	200 fans
Centrifugal fans and associated equipment	4 fans
Cross-passage doors	303 sites
Cross-passage services for bored tunnels	127 sites
Cable containment	120 km of tunnel with multiple ladders in each tunnel
Tunnel fire main	105 km
Tunnel LV distribution	121 km of tunnel with multiple cables in each tunnel and services within
Tunnel lighting	107 km

M&E Systems Contract	Key Data
Tunnel signage	4000 units
Sub-LV distribution to complex areas	28 sites
Sub-LV distribution serving remote radio compounds	55 sites
Earthing works on viaducts	57 sites
Junction lighting and maintenance power supplies	145 locations
Points heating	133 units
M&E SCADA (supervisory control and data acquisition) and interface with MWCC building management systems	1 major system and approximately 50 sites
Tunnel System (TS) SCADA	1 major system and approximately 50 sites

5.2 Tunnel ventilation systems

- 5.2.1 The M&E Systems Contractor will be required to design, supply, install, test and commission the tunnel ventilation systems that provide control of smoke, temperature and pollution within the rail tunnel environment.
- 5.2.2 The permanent ventilation system for bored tunnels will be based on reversible axial fans and associated equipment located within the intervention and ventilation shafts, which are spaced at intervals of up to 3.3 km along the tunnel alignment. These will be supplemented by jet fans installed in the tunnel near the portals.
- 5.2.3 The permanent ventilation system for the shorter tunnels without shafts will be based on jet fans located within each bore of the tunnel, near each portal.
- 5.2.4 A control or Tunnel System (TS) SCADA system will be provided with integral Tunnel Ventilation Control functionality, as well as providing monitoring of the cross-passage doors and other services associated with tunnel emergency evacuation and with fire and rescue services response.
- 5.2.5 The permanent tunnel ventilation system will also include a control workstation at the NICC with interfaces to other systems including EMS, train control, traction power control and station fire alarm systems.
- 5.2.6 The M&E Systems Contractor will be required to design all ventilation systems to provide the capacities and mode tables given in the HS2 Ltd Tunnel Ventilation Analysis Reports. These Reports will be included in the Works Information. In

addition, there are separate detailed technical standards and specifications describing the minimum quality and performance expectations for the plant and materials.

5.2.7 The scope of work also includes the analysis, design, supply, testing, commissioning, operation and maintenance of a tunnel ventilation system for construction use, including early use of permanent fans, dampers, drives, sound attenuators, airways and supporting systems.

5.2.8 The successful M&E Systems Contractor will be expected to undertake several tasks in order to support the adaptation of the construction system for permanent use:

- Planning and design, including co-ordination with MWCC and Others.
- Development, co-ordination and adoption of tunnel construction fire safety strategies.
- Early installation of reversible axial fans and associated equipment located within the intervention and ventilation shafts.
- Provision of temporary in-tunnel jet fans, including wiring and cable containment.
- Connection of these systems to a temporary power supply during construction use, together with provision for all temporary distribution boards and cabling.
- Remote control, operation, monitoring and maintenance of this system.
- Provision of temporary monitoring facilities, systems and processes to ensure the safety of the M&E System contractor’s own workers.
- Replacement and re-conditioning of all necessary equipment following construction use, for incorporation into the permanent works, in accordance with a set of processes and standards that will be set out in the Works Information.

5.3 Tunnel cross-passage systems

5.3.1 The M&E Systems Contractor’s scope of works will include the design, supply, installation, testing and commissioning of a low voltage distribution system within the bored tunnel cross-passages, which will serve the lighting system, cross-passage doors, communications systems equipment and other cross-passage services, including heating, ventilation and air conditioning (HVAC), fire detection and associated alarms and controls, which will either be provided by the M&E Systems Contractor or other contractors.

5.3.2 The M&E Systems Contractor’s scope of work will include the design, supply, installation, testing and commissioning of the TS SCADA to control and monitor all equipment and materials within the bored tunnel cross-passages.

- 5.3.3 HS2 Ltd has undertaken an advanced procurement for the supply of the tunnel-mounted sliding cross-passage doors (CPDs). This NEC 3 Supply Contract includes cross-passage doors, frames, control and monitoring assemblies, alarms and indicators at cross-passages and access/egress points in tunnels.
- 5.3.4 The M&E Systems Contractor will be required to manage the CPD Supply Contractor’s manufacture, supply, delivery, installation, testing and commissioning.
- 5.3.5 This Contract will be novated to the successful M&E System Contractor. Details of the terms and conditions of this contract will be included in the ITT.

5.4 Tunnel low voltage distribution and lighting

- 5.4.1 The M&E Systems Contractor’s scope of works will include the design, supply, installation, testing and commissioning of:
- A lighting system within each tunnel and porous portal, as well as in Victoria Road Box, Copthall Tunnel and Sheephouse Wood bat mitigation structure.
 - The LV systems within the tunnels and associated with the tunnels in the shaft/tunnel portal firefighting points.
 - Power supplies to the rail systems equipment at the East S&C at Old Oak Common and the S&C at Victoria Road Box.
 - Connections to LV switchboards provided by the MWCC at the shafts and firefighting points, cabling in the tunnels to serve cross-passages, and other loads such as trace heating.

5.5 Other tunnel works

- 5.5.1 In certain cases, (to be set out in further detail in the Works information), the M&E Systems Contractor will be required to take over responsibility for operation and maintenance, permanent testing and commissioning of tunnel systems that are installed by the MWCC or other contractors.
- 5.5.2 These systems may include mechanical, electrical and public health (MEPH) systems, plant (including vertical transportation) at shafts and portal buildings.
- 5.5.3 These systems will typically be installed and initially operated and maintained by the MWCC or other contractors, then the operation and maintenance responsibility will be passed to the M&E Systems Contractor to be incorporated in their works. They will subsequently be tested and commissioned on to the permanent power supply by the M&E Systems Contractor prior to handover to HS2 Ltd as part of the permanent works.

- 5.5.4 The M&E Systems Contractor will be required to design, supply, install, test and commission an M&E SCADA system that connects to the Building Management System at shaft and portal buildings provided by others. The M&E SCADA system will harmonise this data and present it to the EMS which is located at the NICC and provided by the EMS contractor.
- 5.5.5 The M&E Systems Contractor’s scope of works will include the design, construction, fixing, installation and commissioning of brackets and longitudinal cable containment or cable management in tunnels, cross-passages, porous portals and covered ways. In the bored tunnels the brackets will be required to be compatible with cast-in sockets provided into the tunnel walls by others. For diaphragm walls, cast-in place or sprayed concrete lining of the tunnels the brackets will require on-site drilling. The cable containment will be required to meet the requirements of the sub-systems included in this M&E contract package and other Railway Systems Contracts, including but not limited to:
- Control, command, signalling and traffic management systems.
 - Telecommunications systems (including radiating cables).
 - HV traction and non-traction power systems.
- 5.5.6 The M&E Systems Contractor will be required to design, supply, install, test and commission the longitudinal pre-charged dry fire main within each tunnel as well as Victoria Road Box and a dry fire main in Copthall, Northern Approaches and Burton Green Tunnel. This work includes the design and provision of the support systems, brackets, anchors and thrust blocks, expansion management, trace heating and insulation, hydrant valves and pressure-reducing equipment.
- 5.5.7 The M&E Systems Contractor will be required to design, supply, install, test and commission escape signage within the tunnels, shafts and portals to meet the requirements of the Safety in Railway Tunnels Technical Specification for Interoperability (TSI-SRT) as well as HS2’s additional requirements for active signage at cross-passages.
- 5.5.8 The M&E Systems Contractor will also be required to design, supply and install handrailing fixed to the tunnel wall for each evacuation walkway.
- 5.5.9 As with other contractors working for HS2 Ltd, the M&E Systems Contractor will be required to collaborate and exchange detailed technical information with HS2 Ltd and its contractors, in order to finalise the design, supply, installation, testing and commissioning of the works.

5.6 Open route LV distribution

5.6.1 The M&E Systems Contractor will be required to design, install, test and commission localised LV power distribution switchgear and accessories, including cables, for essential, non-essential and critical circuits along the route, including those associated with:

- Command, control and signalling systems at S&C, particularly associated with points.
- Power supplies to points motor drive units.
- Operational telecommunications systems.
- Points heating systems.
- Circuit breakers within sub-LV distribution boards for use by security systems.
- Trackside lighting systems (siding and junction lighting).
- Permanent power supplies to remote pumping stations.
- Remote radio compounds.
- M&E SCADA / remote condition monitoring systems

5.6.2 The M&E Systems Contractor will be required to undertake design co-ordination and to support system integration processes, working with Railway Systems Contractors responsible for these systems, throughout the project lifecycle.

5.6.3 The primary supply point for this LV power distribution system will be a series of HV/LV substations, provided by other contractors. The M&E Contractor will provide low voltage distribution panels (LVDPs), uninterruptible power supplies (UPSs), batteries and further sub distribution boards and cabling between the LVDPs and the connected loads.

5.6.4 The M&E Systems Contractor will be required to design and support the testing of the common earthing cables along the trace, including the buried earthing conductor (BEC) and localised earthing pillars and connections.

5.6.5 The M&E Systems Contractor will also be required to design, install, test and commission localised earthing & bonding for the installation of assets identified within this contract. coordinating with other contractors regarding integration of the earthing system.

5.6.6 The M&E Systems Contractor will be required to design, install, test and commission open route lighting for junctions, maintenance loops and turnouts.

5.6.7 The M&E Systems Contractor will be required to provide power and trackside transformers for point heating (with flying leads on 110 V cables) that connect to the

heating elements and sensors (provided and fitted by the Track Systems Contractor /S&C Supplier) and detect the functioning of the points heating equipment.

- 5.6.8 The M&E systems will be required to be energised, operated and maintained to support the commissioning works of the loads they serve, including those required by Others.

5.7 Further items

- 5.7.1 It is intended that the tunnel headhouses will be handed over to the M&E Systems Contractor complete, including all civil and structural works, headhouse mechanical, electrical and plant (MEP), architectural finishes and permanent hard-standing. Temporary works will have been removed and drainage, landscaping, security fencing, lighting and gates will have been installed.

- 5.7.2 The M&E Systems Contractor will be expected to work closely with HS2 Ltd, the Track Systems contractor and other contractors to develop an integrated construction and logistics programme. Subject to this programme, the Track Systems Contractors may provide logistics support and engineering trains to the M&E Systems Contractor for delivery of materials and cabling. The M&E Systems Contractor will provide all necessary information to support this approach, provide site supervision and remain responsible for material supply and installation.

- 5.7.3 The M&E Systems Contractor’s scope of work may include the supply of fire-fighting trolleys.

5.8 Technical support contracts

- 5.8.1 In addition to the obligations in relation to construction ventilation systems referred to in Section 5.2 above, the M&E Systems Contractor will be required to undertake maintenance of all equipment provided within this package between the date of installation and take-over of the Works by the Employer.

- 5.8.2 The M&E Systems Contractor may also be required to undertake temporary operation of M&E systems, including making systems and facilities available to support the installation and testing of other railway systems and HS2 rolling stock.

- 5.8.3 The M&E Systems Contractor will be required to work with HS2 Ltd to procure future maintenance or technical support from original equipment manufacturers and specialist suppliers.

6 Description of the Works – HV Traction and Non-Traction Power Systems

6.1 Introduction

- 6.1.1 There will be one contract including the traction power systems and the HV non-traction power systems on Phases One and 2a.
- 6.1.2 The successful contractor, known as the HV Power Systems Contractor, will be responsible for design, supply, manufacture, installation, testing and commissioning of these systems in open route and tunnels.
- 6.1.3 A separate contract will be awarded for the provision of maintenance services that will commence after completion. Details of the scope of these services and the arrangements for award of contract will be made available with the ITT.
- 6.1.4 Table 8 below contains a short summary of these systems and provides some indicative key data related to this contract.

Table 8 - HV Power Systems Contract key data

HV Power Systems contract scope	Summary description	Key data/ Notes
Traction power system	Autotransformer sites, feeder stations, mid-point autotransformers sites including: <ul style="list-style-type: none"> • HV/LV cabling • control cabling • busbars • HV & LV switchgear • autotransformers • protection and control • battery chargers • LV changeover Possibly also including: <ul style="list-style-type: none"> • load balancing • static VAR compensators • harmonics management 	Approximately 50 railway power compounds, several of which are situated in or near shafts/portals, others in open route. 4 grid supply point which require liaison and interface with National Grid on behalf of HS2 Ltd.
HV non-traction power system	HV/LV substations and lineside HV cabling including:	The HV non-traction network includes sites located at

HV Power Systems contract scope	Summary description	Key data/ Notes
	<p>HV/LV cabling control cabling HV and LV switchgear HV/LV transformers protection and control battery chargers LV changeover</p> <p>Liaison, interface and possible procurement (on behalf of HS2 Ltd) of DNO supplies.</p> <p>HV/LV Interfaces: Stations, shafts and portals - LV terminals of the transformer Open route - main LV board</p> <p>Sub-LV distribution beyond these interfaces will be provided by other contractors, except building services within those buildings provided by the HV Power Systems Contractor.</p>	<p>stations, shafts, portals, railway systems compounds, GSM-R masts and other locations to be determined by the Contractor’s design as necessary to support all non-traction loads throughout Phase One and 2a.</p> <p>Quantities to be stated in the Works Information and/or determined by the Contractor’s design.</p>
Other scope as required or specified	<p>Civil engineering works within railway systems compounds that are not provided by Others (at stations, shafts and portals).</p> <p>Provision of buildings (containerised or otherwise) as required by the HV Power Systems Contractor’s design. Building services for the HV Power Systems Contractor’s buildings.</p> <p>Local control panels (at shafts and feeder station sites). SCADA systems – interfacing to the EMS. Earthing & bonding. Design and construction of cable containment. Signage, keys, locks, labels, etc</p>	<p>Quantities to be stated within the Works Information and / or determined by the HV Power Systems Contractor’s design.</p>

6.1.5 HS2 Ltd will provide Tenderers with sufficient design information in order to develop a cost estimate or Target Cost, thereby reducing the amount of design expected to be undertaken during the tender. For example, HS2 Ltd will provide the major feeding diagram (MFD) for the traction power system (TPS) and non-traction power system (NTPS).

- 6.1.6 The HV Power Systems Contractor will then be responsible for producing an integrated design and for procurement, installation, testing and commissioning of the traction power system (TPS) and non-traction power system (NTPS).
- 6.1.7 The location, type, feeding arrangement, electrical configuration and sectioning of the following sites will be included in the Works information:
- Autotransformer sites (ATS)
 - Autotransformer feeder stations (ATFS)
 - Mid-point autotransformer sites (MPATS)
 - HV/LV substations – various configurations
- 6.1.8 The HV Power Systems Contractor will be required to determine the details of the plant and materials to be provided and how these will be designed and configured within the constraints of the requirements and specifications set out in the Works Information.
- 6.1.9 The HV Power Systems Contractor will be required to supply traction and non-traction power connections to the HS2 Rolling Stock Maintenance Depot and NICC at Washwood Heath (Birmingham).
- 6.1.10 Some power intakes for the permanent non-traction power system network will be derived from Distribution Network Operator (DNO) connections provided by HS2 Ltd or Others for construction purposes, these are to be reconfigured by the HV Power Systems Contractor for permanent use. The HV Power Systems Contractor may also be required to seek additional connections to the DNO as necessary to complete the works.
- 6.1.11 The HV Power Systems Contractor will be required to provide temporary supplies for construction use at railway systems compounds (RSCs) in the open route. This work may involve adopting temporary supplies previously provided by the MWCC.
- 6.1.12 The HV Power Systems Contractor will be required to design, supply and install all primary and secondary cable containment within the railway systems compounds.

6.2 Traction power system

- 6.2.1 The traction power system (TPS) will be an autotransformer system designed to supply the OCS at 25–0–25 kV 50 Hz AC with a nominal maximum fault level of 15 kA.
- 6.2.2 The HV Power Systems Contractor will design, supply, test and commission all ATFS, ATS and MPATS required by the TPS, together with all 25 kV switchgear and all

associated auxiliary systems within the ATS, ATFS and MPATS. Switchgear may be gas or air-insulated (indoor or outdoor), depending on individual site requirements and commercial considerations.

- 6.2.3 HS2 Ltd has undertaken multi-train simulation studies in order to ensure that the TPS meets the HS2 project requirements.
- 6.2.4 HS2 Ltd is putting in place connection agreements with National Grid Plc (NG), who will provide four Grid Supply Points (GSPs) at Ickenham, Quainton, Burton Green and Newlands Lane that feed the corresponding HS2 ATFS sites for Phases One and 2a.
- 6.2.5 The HV Power Systems Contractor will design, supply, test and commission the interface with NG at the GSP locations.
- 6.2.6 HS2 Ltd and NG are undertaking system modelling to ascertain the requirement for load balancing at the NG sites. If necessary, the HV Power Systems Contractor will be required to provide static var compensator, load balancing and/or harmonic control capability at the ATFS. Further details will be provided with the Works Information.
- 6.2.7 The HV Power Systems Contractor will design, supply, test and commission HV system up to the point of connection to the OCS system.
- 6.2.8 The HV Power Systems Contractor will also be required to design, supply, test and commission LV, control and communications cabling in the ATFS, ATS and MPATS up to the point of connection with other contractors (to be defined in the Works Information).

6.3 HV non-traction power system

- 6.3.1 The HV non-traction power system (NTPS) will supply all permanent non-traction power loads in tunnels and open route, via a series of intakes from the DNO, HV/LV substations connected by a lineside HV cable network.
- 6.3.2 The non-traction HV/LV substations will be 33 kV/400 V or 11 kV/400 V based on the specific characteristics of the points of connection with the local distribution network, the trackside non-traction system architecture and the downstream sub-system load requirements.

- 6.3.3 The HV Power Systems Contractor will be required to design, supply, test and commission the HV NTPS along the trace and at specific locations, such as stations, shafts and portals, depending on the load requirements. These systems will include HV switchgear, HV cabling, HV/LV transformers, primary LV distribution boards (in open route sections) and all necessary ancillary plant.
- 6.3.4 As part of the design process the HV Power Systems Contractor will be required to reconfirm load requirements with other contractors and model the HV NTPS, to optimise the design and to ensure that the balance of trackside power distribution and DNO connections is suitable for the supply of the downstream sub-system load requirements.
- 6.3.5 The HV Power Systems Contractor will be required to work closely with HS2 Ltd and other contractors to ensure that their power requirements are met by the HV NTPS, taking the lead role in co-ordinating load apportionment across the network.
- 6.3.6 The HV Power Systems Contractor will be required to produce protection settings and co-ordinate protection setting up and down stream to ensure adequate discrimination, in line with industry standards.
- 6.3.7 The HV Power Systems Contractor will also be required to undertake all or some of the necessary stages (design, procurement, installation, testing and commissioning) that are required to connect the DNO supply to the HV NTPS.
- 6.3.8 In some instances HS2 Ltd or other contractors (including the MWCC) have already established supplies from the DNO for construction purposes, in which case the HV Power Systems Contractor will be required to design, supply, test and commission a reconfiguration of that supply so that it forms a suitable intake for the permanent HV non-traction network.
- 6.3.9 Where the HV Power System Contractor design determines that an HV/LV substation is required to support the downstream sub-system loads and this location is not coincident with stations, shafts, portals or an RSC. The HV Power Systems Contractor will be required to determine a suitable lineside location and undertake all necessary works.
- 6.3.10 In some cases, the HV Power Systems Contractor will be required to procure a supply from the DNO, on behalf of HS2 Ltd, including coordination of all contestable and non-contestable works from design through to handover.

- 6.3.11 In stations, shafts and tunnel portals the scope boundary between the HV Power Systems Contractor’s works and those of Others will be located at the secondary side of the supply transformer.
- 6.3.12 In open route the scope boundary between the HV Power Systems Contractor and other contractors will be the outgoing ways of the primary LV distribution board.
- 6.3.13 The HV Power Systems Contractor will be required to supply and install all HV cables within the HV/LV substations and along the track as determined by their design.
- 6.3.14 The HV Power Systems Contractor will also be required to supply and install all primary and secondary cable containment within the HV/LV substations which are remote from the railway systems compounds.
- 6.3.15 The Track Systems Contractors and the Tunnel and Lineside M&E Systems Contractor will be responsible for the installation of all primary longitudinal cable containment in tunnels and open route. The MWCC will install all primary cable containment in stations, shafts and portals.

6.4 Interfaces and general requirements

Open route railway systems compounds

- 6.4.1 The MWCC will provide an area of level ground at the railway systems compounds, temporary fencing, mains drainage connections and an access road connection to the highway. The HV Power Systems Contractor will be required to adopt the railway system compounds and assume the role of Principal Contractor, including taking responsibility for site security and access control.
- 6.4.2 The HV Power Systems Contractor may be required to carry out minor enabling works for railway systems infrastructure where this has not been provided by the MWCC. The HV Power Systems Contractor will also be required to comply with planning processes and constraints set out in the Works Information, including making applications to the Local Authority in accordance with Schedule 17 of the HS2 Act.
- 6.4.3 The HV Power Systems Contractor will be responsible for the co-ordination and layout design of each of these compounds, optimising the design to account for the requirements of other Railway Systems Contractors, including access and egress provisions, the track position, OCS power structure positions, cable containment, communications systems, command control and signalling systems.

- 6.4.4 The HV Power Systems Contractor will be required to provide buildings (containerised or otherwise) for HV equipment, including building services within these compounds. Buildings for other Railway Systems Contractors that are located within the railway systems compounds are excluded from the HV Power Systems Contractor’s scope, but close co-ordination will be required to optimise the site layout.
- 6.4.5 The HV Power Systems Contractor will be responsible for the design and provision of the civil engineering works required for all the TPS and NTPS infrastructure within the scope of this contract.
- 6.4.6 As part of the HV non-traction power HV/LV substation within the railway systems compound, the HV Power Systems Contractor will also provide an appropriately-rated main LV distribution board for the railway systems infrastructure, for use by other sub-systems. The LV sub-distribution from these boards will be the responsibility of other rail systems contractors.
- 6.4.7 The HV Power Systems Contractor will provide all cable management within the railway systems compounds (excluding local or secondary trough or ducting required by other rail systems contractors within their sub-compounds).
- 6.4.8 The HV Power Systems Contractor will be required to provide earthing, security fencing, security provisions, final compound finishes, internal compound roads, compound drainage and landscaping.
- 6.4.9 Longitudinal cable containment between the compounds (along the trace) will be provided by the Track System Contractors.

Stations, Shaft and Portal Substations

- 6.4.10 The HV non-traction and traction power system plant rooms and cable routes/risers within the stations, shafts, portals will be constructed by the MWCC and station contractors, in accordance with HS2 standards. These will make appropriate allowances for the requirements of the HV Power Systems Contractor.
- 6.4.11 The HV Power Systems Contractor will be responsible for the layout of their plant within these rooms.
- 6.4.12 The MWCC will be responsible for building services within these plant rooms to the HV Power Systems Contractor’s specifications.

6.4.13 Primary cable containment between plant rooms and areas within the shafts, portals and tunnels will be provided by other contractors. The HV Power Systems Contractor will provide internal secondary cable containment within plant rooms.

Earthing and Bonding

6.4.14 HS2 Ltd will undertake the system-level design for earthing and bonding, to be applied by the relevant contractors, in accordance with the requirements of the Works Information (HS2 Earthing and Bonding Guidance).

6.4.15 Within railway systems compounds and remote HV/LV substations the HV Power Systems Contractor will be responsible for the design, installation, testing and commissioning of a suitably-rated substation earthing system, including the sub-surface earthing. The Contractor will facilitate the earthing and equipotential bonding of all equipment frames, cubicles, support steel works and extraneous conductors.

6.4.16 Within the railway systems compounds, the HV Power Systems Contractor will also be responsible for the earthing and bonding integration and co-ordination between other railway system contractors.

6.4.17 The HV Power Systems contractor will be responsible for the design, supply, installation, testing and commissioning of a traction return bonding system for each traction power substation site.

6.4.18 In the stations, shafts and portals, the MWCC and stations contractors will be responsible for the design, installation, testing and commissioning of a suitably-rated earthing system. The main building earth will be brought to the HV Power Systems plant rooms by the MWCC and stations contractors. The HV Power Systems Contractor will be responsible for the local earthing within the rooms.

6.4.19 Longitudinal earthing (along the track) in the form of a buried earth conductor or an aerial earth conductor will be provided by other contractors.

Cabling and Cable Containment

6.4.20 The Track Systems Contractors and Tunnel & Lineside M&E System Contractor will supply and install all primary longitudinal cable containment.

6.4.21 The HV Power Systems Contractor will be required to work with HS2 Ltd and Others to design this containment system for HV cables.

- 6.4.22 The HV Power Systems Contractor will be required to design, supply and install all secondary cable containment, including connections from the open route longitudinal cable management system to the railway system compounds, as determined by its design.
- 6.4.23 The HV Power Systems Contractor will be responsible for the design, supply, installation, testing and commissioning of all cables, joints and terminations associated with the traction and HV non-traction power systems in open route and in tunnels.

Logistics

- 6.4.24 The HV Power Systems Contractor will be expected to work closely with HS2 Ltd the Track Systems contractor and other contractors to develop an integrated construction and logistics programme. Subject to this programme, the Track Systems Contractors may provide logistics support and engineering trains to the HV Power Systems Contractor for delivery and installation of cabling. The HV Power Systems Contractor will provide all necessary information to support this approach, provide site supervision and remain responsible for material supply and installation.

Supervisory Control and Data Acquisition (SCADA), Communications and Other Systems

- 6.4.25 The HV Power Systems Contractor will be responsible for the design, supply, installation, testing and commissioning of the HV Systems SCADA to manage the TPS and NTPS. This SCADA system will interface with the EMS at the NICC and others (to be defined in the Works Information).
- 6.4.26 In addition, the HV Power Systems Contractor will be responsible for incorporating remote control, alarms and status indications for plant associated with the OCS system into the HV Systems SCADA.
- 6.4.27 The HV Power Systems Contractor will be responsible for the design, supply, installation, testing and commissioning of voice and data communication systems within the substation buildings and all data communications equipment to interface with the route-wide DTN, in accordance with HS2 Ltd standards and specifications. Some voice and data communications plant (to be defined in the Works Information) including the route-wide DTN will be provided by the Operational Telecommunications Contractor.
- 6.4.28 The HV Power Systems Contractor will be responsible for the design, supply, installation, testing and commissioning of protection and control (P&C) schemes associated with the traction and non-traction power systems, as well as for the

integration of these P&C schemes with the SCADA, DTN, OCS and communications systems. The P&C scheme will utilise dark fibres provided by the Operational Telecommunications Contractor.

- 6.4.29 The HV Power Systems Contractor will be responsible for the design, supply, installation, testing and commissioning of appropriate battery and charging units for each substation within the traction and HV non-traction power systems, in accordance with HS2 Ltd standards and specifications.
- 6.4.30 The HV Power Systems Contractor will be responsible for design, supply, installation, testing and commissioning of all signage and labels required for the HV plant.
- 6.4.31 The HV Power Systems Contractor will be responsible for design, supply, installation, testing and commissioning of all physical security required for the HV plant including cameras, physical locks, keys and fencing.
- 6.4.32 The HV Power Systems Contractor will design, supply, install, test and commission a compound access gate system that will be developed in collaboration with HS2 Ltd and other contractors to be consistent throughout the route, in accordance with HS2 Ltd standards and specifications.

6.5 Maintenance and technical support contracts

- 6.5.1 The HV Power Systems Contractor will also be required to undertake maintenance of all equipment provided within this package between the date of installation and take-over of the Works by the Employer.
- 6.5.2 The HV Power Systems Contractor may also be required to undertake temporary operation of the traction and non-traction power systems, including making systems and facilities available to support the installation and testing of HS2 rolling stock and other railway systems.
- 6.5.3 The HV Power Systems Contractor will be required to provide ongoing technical support and spares supply to the maintainer, under a separate maintenance contract for a minimum period of 7 years from sectional completion or completion.
- 6.5.4 The HV Power Systems Contractor’s team will form an integral part of the HS2 Ltd Infrastructure Manager’s organisation and will work under the HS2 Ltd safety management and quality management systems, co-located at Calvert IMD.
- 6.5.5 Details of the scope of services included in the maintenance contract and the arrangements for award of this contract will be made available with the ITT.

7 Description of the Works - Operational Telecommunications and Security

7.1 Introduction

7.1.1 The Operational Telecommunications Contractor will be responsible for the design, manufacture, supply, installation, safety authorisation, testing, commissioning and maintenance (until take-over by the Employer) of the operational telecommunication systems and the route wide security systems on Phase One and 2a.

7.1.2 A separate contract will be awarded for the provision of technical support services. Details of the scope of these services and the arrangements for award of contract will be made available with the ITT.

7.2 Operational Telecommunications and Security scope

7.2.1 The Operational Telecommunications Contractor’s scope includes the following systems:

- data transmission network (DTN)
- operational telephony system (OTS)
- tunnel radio system (TRS)
- telecommunication masts
- GSM-R radio network, including base transmission stations (BTS), antenna, etc.
- relocatable equipment buildings (REBs)
- route wide security systems
- passive provision for Airwave

7.2.2 A separate contract will be awarded for Third Party Telecommunications which will include:

- Passenger communication systems, based on mobile network operator (MNO) technology in stations and along the line of route (including base station hotel, radio transmitter equipment, tower antenna and provision of service).
- Emergency services network (ESN), including base station hotel, radio transmitter equipment, tower antenna and provision of service. The Third

Party Telecommunications Contractor will be responsible for the delivery of the ESN service on the HS2 infrastructure.

- The station data network (including network device, WI-FI access points, configuration, management communication service and external services).
- Non-rail/rural communications (including commercial management and configuration of non-rail services).

7.2.3 The Operational Telecommunications Contractor will be expected to take a leading role in the managing of interfaces between the telecommunication and other contracts. Further details of interface management processes and the roles of Prime and Lead Systems Integrator will be set out in the Works information.

7.3 Data transmission network

7.3.1 The DTN will form the backbone of digital communication links across HS2. Using a fibre-optic bearer and internet protocol (IP), the network will provide high-speed, high-bandwidth, high-availability and low-latency data transmission circuits, designed to meet BS EN 50159:2010 Category 2 (open network) standards.

7.3.2 The DTN will provide transmission services to a number of operational railway systems including signalling, SCADA, voice communications, radio, security and M&E control systems. It will also provide transmission services to HS2 Ltd, third party operational and business systems across the HS2 route.

7.3.3 The DTN fibre-optic network (FON) will connect DTN network switches located in HS2 operational sites, such as:

- NICC and remote tap-in facility (for railway operational systems only)
- stations (railway operational systems only)
- depots (railway operational systems only)
- railway system compound equipment rooms
- radio mast compound equipment rooms
- trackside enclosures (LV distribution points and sub-LV panels)
- tunnel equipment rooms (portals and shafts)
- tunnel cross-passages

7.3.4 Network management for the DTN system will be available at the NICC.

7.3.5 The DTN security information and event management (SIEM) systems will provide threat detection and support security incident response and a secure gateway will be required for connections from external systems.

7.3.6 The Operational Telecommunications Contractor will ensure that the DTN systems provide the following network services for HS2:

- An IP address management system, using a dynamic host configuration protocol (DHCP).
- A domain name system (DNS).
- An active directory.
- Remote authentication dial-in user service (RADIUS).

7.3.7 The Contractor will be expected to manage the provision of these operational systems, working in conjunction with HS2 Ltd and the other Railway Systems Contractors.

7.3.8 The DTN will provide clock synchronisation to all HS2 operational systems, using coordinated universal time (UTC).

7.4 Operational telephony system

7.4.1 The HS2 operational telephony system (OTS) will provide a fixed-line voice communication network to support the operation of HS2, including a private branch exchange (PBX), voice recorder and call logger systems.

7.4.2 The OTS will include terminals at the NICC, stations, track-side equipment rooms and depots. It will also include the tunnel emergency telephone system for the safe management of incidents in these critical locations and will have links to external telephone networks to provide operational voice communications outside HS2.

7.4.3 Network management for the OTS will be available at the NICC. The network management system will support the forwarding of alarm and network performance data to external HS2 systems.

7.5 Tunnel radio system

7.5.1 The following radio systems need to be available to end users within the HS2 tunnels:

- GSM-R and Fireground, which will be provided under this Operational Telecommunications Contract.
- ESN and MNO services, which will be provided via the Third Party Communications Contract.

- 7.5.2 The tunnel radio systems will include all radiating cables, portal antennas, couplers/combiners, coaxial feeder cables and base station points of interface, in order to propagate the required radio coverage through the tunnel bores, in equipment rooms, in cross-passages, at firefighting points and through evacuation routes, as appropriate.
- 7.5.3 The Operational Telecommunications Contractor’s tunnel radio system will include the active equipment required for the Fireground system to allow the fire and rescue services to use their own mobile handsets for incident communication within HS2 tunnels. This system will be configurable to support either analogue or digital radio access network and have the ability to self-test the radio coverage.
- 7.5.4 The tunnel radio systems, Fireground equipment and self-test facility will be required to support remote management and to present alarms and events at the NICC.
- 7.5.5 The Operational Telecommunications Contractor will be required to take into account the functional requirements of ESN and MNO services in the design of the tunnel radio system.
- 7.5.6 The programme for the ESN project and dates for discontinuation of the Airwave radio system has a level of uncertainty. Passive provision (space, power, frequency band) will be allowed for in the delivery HS2 tunnel radio systems to facilitate the Airwave radio network.
- 7.5.7 As the programme for ESN is further developed, it may be required to include the provision of the Airwave system to provide radio coverage within the HS2 tunnels to allow the emergency services to use their own handsets. Further information on this subject will be included with the ITT.

7.6 Telecommunication towers

- 7.6.1 The Operational Telecommunications contract will include the design, construction and installation of the radio towers to support radio network coverage across the HS2 open route for the following radio technologies:
- GSM-R - train roof antennae and trackside mobile handsets
 - MNO - train roof antennae to onboard repeaters and Wi-Fi media gateways
 - ESN - trackside mobile handsets
- 7.6.2 The location and height for these structures will be provided to the Contractor, based on GSM-R radio planning carried out by Others. The details of radio mast planning will be provided with the ITT.

7.6.3 The Operational Telecommunications Contractor will be expected to work with HS2 Ltd to secure the necessary design and construction consents in accordance with Schedule 17 of the HS2 Act in relation to the location and design of structures within their scope of work. Further details of the consents process will be included in the Works Information.

7.6.4 The tower design will be suitable for installation and replacement within an operational railway environment.

7.7 Relocatable equipment buildings

7.7.1 REBs will be provided by Operational Telecommunications Contractor for DTN, GSM-R, line of route security and Third Party Telecommunications systems.

7.7.2 The REBs will include building, fire and access control systems, which will be integrated into the HS2 EMS for centralised management at the NICC.

7.7.3 Where required, the REBs will include uninterruptable power supplies (UPS) that provide protection for the operational telecommunication systems.

7.7.4 The design of REBs will mitigate the security risk level defined in the Threat and Vulnerability Risk Assessment, details of which will be provided with the ITT.

7.8 Route wide security

7.8.1 The Operational Telecommunications Contractor will be responsible for the delivery of electronic security measures along the HS2 Open Line of route described below, details of which will be included in the Works Information.

- Perimeter protection
- Video surveillance
- Access control
- Intruder detection

7.8.2 The Operational Telecommunications Contractor will be responsible for selecting the security applications described below, details of which will be included in the Works Information.

- physical security information management system (PSIM)
- video management system (VMS)
- access control system (ACS)
- perimeter intrusion detection system (PIDS)

- 7.8.3 The Operational Telecommunications Contractor will be responsible for leading integration of the security applications with other HS2 contracts, working with HS2 Ltd and the other contractors responsible for these facilities.
- 7.8.4 The Operational Telecommunications Contractor will be required to design the systems that mitigate security risks by providing suitable protection to HS2 infrastructure, staff, customers and members of the general public along the route.
- 7.8.5 The Operational Telecommunications Contractor’s scope will include all equipment, cabinets, power and data communications, (from the local distribution point to the end device) and cable management from the route wide troughing to the end device.
- 7.8.6 The Operational Telecommunications Contractor will also be required to provide access control locks, intrusion prevention systems and structures such as camera masts.

7.9 GSM-R radio access network

- 7.9.1 A GSM-R radio communication system is required that will support both voice and data communications along the HS2 route, including points of transition with Network Rail infrastructure and at HS2 depots.
- 7.9.2 HS2 Ltd intends to use GSM-R to perform or support the following functions:
- signalling (ETCS Level 2 Baseline 3 trackside to train communications for data)
 - ATO (trackside to train communications for data)
 - voice communications (from trackside to train)
 - key management (for public encryption keys of onboard systems)
 - maintenance workers’ voice communications
- 7.9.3 Network Rail, under contract with HS2 Ltd, will undertake all works necessary within the GB GSM-R core (network switching sub-system and base station controller) to extend and upgrade the national GSM-R system, including general packet radio services (GPRS). This will include upgrading GSM-R lineside equipment on Network Rail infrastructure to accommodate the HS2 route and HS2 Ltd requirements.
- 7.9.4 The Operational Telecommunications Contractor will be required to provide lineside GSM-R base stations along the HS2 Phase One and Phase 2a route.

7.9.5 The equipment provided by the Operational Telecommunications Contractor will support the proposed performance level of ETCS and ATO with the required quality of service:

- Along the Phase One and 2a route (within the HS2 estate), including tunnels and station platforms.
- Along sufficient Network Rail infrastructure to permit transitions into and from the HS2 infrastructure (as required).
- In depot areas - to support transitions onto the HS2 main line.

7.9.6 The Operational Telecommunications Contractor will provide and commission portable GSM-R handsets for HS2 Ltd staff as required. SIM cards will be provided by Network Rail.

7.9.7 The Operational Telecommunications Contractor will provide and commission GSM-R fixed terminals for all relevant control centre operator positions. The fixed terminal (operator handsets) will be provided as part of HS2 scope of work, connected to the fixed terminal sub-system core that is provided by Network Rail at Stoke.

7.10 Interface management responsibilities

7.10.1 The HS2 Operational Telecommunications Contractor will be required to take the lead in the technical integration of shared telecommunication systems.

7.10.2 In particular, the following systems will be shared between the Operational Telecommunications Contractor and the Third Party Telecommunications Contractor:

- fibre-optic network capacity and point of presence
- radio mast capacity for antenna equipment
- tunnel distributed antenna system (TDAS) radiating cables

7.10.3 The Operational Telecommunications Contractor’s design will also be required to support the communications requirements of other systems, including those provided by other Railway Systems Contractors, station contractors, etc, who have responsibility for:

- track and OCS systems
- tunnel and lineside M&E systems, including tunnel SCADA
- HV traction and non-traction power systems
- Third Party telecommunication systems (ESN, wireless networks for train and passenger comms)

- control, command and signalling systems
- EMS
- Depot and NICC systems
- station systems
- security systems (access control, intruder detection and video surveillance)
- HS2 business systems
- interfaces to other data telecoms systems
- Network Rail fixed transmission network (FTN-X)
- public internet service providers’ systems
- controlled-access gateways for Third Party system support/ diagnostics/ maintenance

7.10.4 The Operational Telecommunications Contractor will also undertake Radio Frequency (RF) management activities, (interference, inter-modulation etc.) for all HS2 radio systems including, but not limited to:

- GSM-R
- Fireground
- ESN
- MNOs
- Wi-Fi
- station and depot local communications
- platform dispatch and platform edge door wireless communications

7.10.5 During construction, testing and commissioning, the Operational Telecommunications Contractor will act as HS2’s technical authority for any radio frequency transmission equipment installed on HS2 infrastructure.

7.11 System integration facility

7.11.1 The Operational Telecommunications Contractor will be responsible for the DTN and GSM-R systems that are required in the SIF and will identify to HS2 Ltd their hardware and software requirements, providing support and resources during the delivery stages of the programme.

7.11.2 A specific CCS Integration Laboratory will be provided by the CCS and TM Contractor in order to test interfaces and functionality that are specific to the CCS Systems. The GSM-R equipment for this Laboratory will be provided by the Operational Telecommunications Contractor.

7.11.3 Both the SIF and the CCS Integration Laboratory will be located in HS2 Ltd buildings provided and fitted-out by Others.

7.12 Cabling and cable protection

7.12.1 The Operational Telecommunications Contractor will be required to design, supply and install:

- Fibre optic cable, tunnel radiating cable, coaxial feeder cable, structure data cable (up to the local patch panel) and other cables as required.
- All power cabling from their equipment to a local distribution board.
- All secondary cable containment and cable management from their trackside equipment to the primary cable containment provided by Others.
- cabling protection for their cabling, which will include armoured cable with proven resilience to theft, vandalism and rodent/animal damage.
- Radiating cables within the tunnel complex including tunnel bores, evacuation/intervention shafts, corridors, equipment rooms and buildings, with suitable fire rating.
- Cable labelling on cables that are within their scope to HS2 standards.

7.12.2 The Operational Telecommunications Contractor will be expected to work closely with the HS2 Ltd Track Systems Contractors and other contractors to develop an integrated construction and logistics programme. Subject to this programme, the Track Systems Contractors may provide logistics support and engineering trains to the Operational Telecommunications Contractor for delivery and installation of cabling. The Operational Telecommunications Contractor will provide all necessary information to support this approach, provide site supervision and remain responsible for material supply and installation.

7.13 Civil engineering works

7.13.1 The Operational Telecommunications Contractor will design and provide all minor civil engineering works required for the telecommunications and security trackside equipment, concrete bases, masts, mast bases, ducting, equipment fixings, equipment housings and lineside buildings such as REBs where appropriate.

7.14 Maintenance and technical support services

7.14.1 The Operational Telecommunications Contractor will also undertake maintenance of all equipment provided within this package between the date of installation and take-over of the Works by the Employer at the end of dynamic testing.

7.14.2 The Operational Telecommunications Contractor may also be required to undertake temporary operation of certain systems, including making systems and facilities

available to support the installation and testing of other railway systems and HS2 rolling stock.

- 7.14.3 The Operational Telecommunications Contractor will be required to provide ongoing technical support and spares supply to the maintainer, under a separate technical support contract (TSC) for a minimum period of 8 years.
- 7.14.4 For the operational telecommunication systems, it is proposed that rapid response, Level 1 and Level 2 maintenance will be undertaken by HS2 Ltd. This includes preventative and reactive maintenance. The Operational Telecommunications TSC will include Level 3 services (off-site and on-site support, provision of spares), training and obsolescence management (Level 4).
- 7.14.5 All software source code, hardware designs and specifications will be held in escrow.
- 7.14.6 Details of the scope of services included in the TSC and the arrangements for award of this contract will be made available with the Invitation to Tender for the Operational Telecommunications Contract.

8 Description of the Works - Third Party Telecommunications

8.1 Introduction

8.1.1 The scope of the Third Party Telecommunications Contract will be:

- Passenger communication systems, based on MNO technology in stations and along the line of route (including base station hotel, radio transmitter equipment, tower antenna and provision of service).
- Emergency Services Network, including base station hotel, radio transmitter equipment, tower antenna and provision of service. The Third Party Telecommunications Contractor will be responsible for the delivery of the ESN service on the HS2 infrastructure.
- The station data network (including network device, WI-FI access points, configuration, management communication service and external services).
- Non-rail/rural communications (including commercial management and configuration of non-rail services).

8.2 HS2 service performance requirements

8.2.1 The HS2 on-board passenger connectivity requirement is for a minimum bi-directional data rate of 525 Mbps (circa 375 Mbps DL and 150 Mbps UL) per train.

8.2.2 Based on speed, cell size and number of trains, the proportion of time with cell double occupancy is estimated to be up to 17%.

8.2.3 The HS2 customer connectivity requirements within stations will be based on industry and market expectations at the time of design. The estimated daily footfall within HS2 stations, at initial opening and under full operational service, is shown in Table 9.

Table 9 - HS2 Station customer footfall (thousands /day)

	Phase One Initial Opening	Full HS2 Operational Service
Euston	77.3 - 89.4	137.4 - 161.2
Old Oak Common	47.7 - 54.9	86.6 - 101
Birmingham Interchange	19.0 - 22.4	25.2 - 29.7
Birmingham Curzon Street	30.7 - 62.5	51.9 - 62.5

8.3 Third Party Telecommunications scope

Passenger communication systems

- 8.3.1 The passenger communications systems provide voice and data mobile communications for HS2 customers when using the HS2 service. These systems will provide access to voice and data mobile services within stations and on-board trains throughout the HS2 estate (along the line of route and in tunnels).
- 8.3.2 The Third Party Telecommunications Contractor will design, build, test and commission the radio access network (RAN) to provide mobile cellular communication across the HS2 estate.
- 8.3.3 The Third Party Telecommunications Contractor will engage with and manage the commercial arrangements with the MNOs, to provide cellular mobile coverage to HS2 customers via an open access agreement.
- 8.3.4 It is expected that the Third Party Telecommunications Contractor will take an element of risk on the commercial arrangements agreed with the MNOs.

Emergency Services Network

- 8.3.5 The ESN coverage will be provided in stations, tunnels, depots and along the line of route to facilitate mobile communications for emergency response organisations.
- 8.3.6 The Third Party Telecommunication Contractor will design, build, test and commission the RAN to provide ESN coverage across the HS2 estate. They will also engage with and manage the commercial arrangements with the ESN provider, on behalf of HS2 Ltd.

Station Data Network

- 8.3.7 The station data network (SDN), including fixed, operational Wi-Fi and public Wi-Fi, will be based upon Internet Protocol transmission and will form the communication network within all public and operational station areas.
- 8.3.8 The SDN will provide transmission services to HS2 Ltd station operational systems, retail systems, customer information systems, customer communication and business systems within the HS2 stations.
- 8.3.9 The Third Party Telecommunications Contractor will design, build, test and commission the SDN including the network and Wi-Fi equipment.

8.3.10 The Third Party Telecommunications Contractor will also design, build, test and commission the distributed antenna system (DAS) to support ESN, Mobile Cellular and Wi-Fi technologies throughout the HS2 stations.

Non-rail/other communication services

8.3.11 HS2 is required to provide capacity to offer fibre optic connectivity for third party, non-rail use along the line of route.

8.3.12 The Third Party Telecommunication Contractor will engage with stakeholders and manage commercial arrangements for provision of third party/non-rail communication services in order to provide digital connectivity to external parties on an open access agreement.

8.3.13 It is expected that the Third Party Telecommunication Contractor would take the risk on the commercial arrangements agreed with external parties, resulting in a mutually acceptable commercial benefit to the Operator and HS2 Ltd.

8.4 Interfaces with other HS2 contracts

8.4.1 The Third Party Telecommunications Contractor will be expected to work closely with the Operational Telecommunications Contractor and other Railway Systems Contractors in order to define and manage interfaces between systems. In particular:

- Capacity on the fibre-optic DTN backbone will be provided on HS2 estate for the use of Third Party Telecommunication Contractor’s systems.
- Third Party Telecommunication Contractor’s radio systems will use the tunnel DAS and DTN fibre backbone to provide coverage within HS2 tunnels.
- Equipment room space will be provided for the Third Party Telecommunication Contractor’s systems at tunnel portals and in cross-passages. These will include power supply, lighting, environmental control and security.
- Capacity for the Third Party Telecommunications Contractor’s radio systems antenna equipment will be provided on the HS2 telecommunication masts.
- Lineside equipment rooms will be provided for the Third Party Telecommunication Contractor’s systems within the HS2 estate. These will include power supply, lighting, environmental control and security.
- Equipment rooms will be provided within HS2 stations for Third Party Telecommunication Contractor’s systems. These will include power supply, lighting, environmental control and security.
- Capacity on the station fibre optic backbone and data cabling network will be provided for the Third Party Contractor’s communication systems.
- The HS2 rolling stock will include mobile cellular repeaters and Wi-Fi media gateways.

9 Description of the Works - Engineering Management System

9.1 Introduction

9.1.1 There will be one Engineering Management System (EMS) contract covering Phases One and 2a.

9.1.2 The successful Contractor, referred to in this section as the EMS Contractor, will be responsible for the design, manufacture, supply, installation, integration, testing and commissioning of the EMS.

9.1.3 The EMS contractor may be responsible for the following Phase 2b works:

- The extension of the Phase One / 2a EMS to cover Phase 2b.
- The EMS works required for the Phase 2b alterations at Euston station including additional platforms.

9.1.4 A separate contract will be awarded for the provision of technical support services that will commence after completion. Details of the scope of these services and the arrangements for award of contract will be made available with the ITT.

9.2 System scope

9.2.1 The EMS will be an integrated software solution, capable of providing HS2 operations staff with remote supervisory control and monitoring of the railway infrastructure assets and systems from the NICC. It will also support maintenance management of assets from different key locations.

9.2.2 The EMS will be the primary user interface to operate and coordinate the maintenance of the railway infrastructure (implement isolations, select tunnel ventilation operational modes, monitor the health of assets and systems, etc).

9.2.3 The function of the EMS will be to provide:

- A consolidated graphical user interface (GUI) for the end user.
- Alarm management for the railway infrastructure.
- Differentiated graphical and functional representations of the system to different users, depending on their role and responsibilities.
- Configurable allocation of controls and monitoring responsibility between different users of the system.

- 9.2.4 The EMS will also support efficient management and maintenance of the infrastructure and critical decision-making by operational staff through diagnostic and analytical functionality, in accordance with the ‘predict and prevent’ approach to asset management.
- 9.2.5 End users will access the EMS via user interface terminals at the NICC, a remote ‘tap in’ facility at Birmingham Curzon Street and through maintenance facilities at Calvert IMD and Stone IMB-R.
- 9.2.6 The EMS system hardware and user interface terminals will be connected to designated DTN access points and power supply connections, located at specified locations on HS2 premises.
- 9.2.7 The EMS will not include provision of operational functionality for stations, depots or rolling stock. These will have their own management systems, but the EMS will monitor critical assets at these locations that may affect train service delivery and require coordination from the NICC.
- 9.2.8 The EMS will not include provision of operational functionality for command control and signalling or open route security systems but will monitor certain infrastructure within these domains that require coordinated maintenance from the NICC.
- 9.2.9 The EMS Contract will also provide of an EMS training system, which will be integrated with other systems to support HS2 operation and maintenance staff training using simulated or replayed real events. Simulators, ‘train the trainer’ activities and manuals will also be required.
- 9.2.10 As HS2 will be built in phases, the EMS will be scalable and allow for future expansions of the system without affecting software that has already been commissioned.
- 9.2.11 The EMS will be required to comply with the cyber security model that has been implemented by HS2 Ltd.
- 9.2.12 The EMS Contractor will not be required to undertake Principal Contractor (PC) responsibilities under the CDM Regulations but will be expected to act as a Designer and Contractor as appropriate.
- 9.2.13 Further details of these requirements will be set out in the Works information.

9.3 System integration

- 9.3.1 The EMS will integrate multiple systems, consolidating data acquisition and control across a number of contracts and providing operational functionality.
- 9.3.2 Given the nature of some of the interfacing systems, certain safety-related functions will be integrated within the EMS. Details of these and the specific allocation of safety management responsibilities will be set out in the Works information.
- 9.3.3 Contractors with systems that have an interface with the EMS will be required to provide design information, specifications and technical support from subject matter experts in order to facilitate interface design and integration with the EMS.
- 9.3.4 The EMS Contractor will manage the interface with these contractors in order to deliver an integrated supervisory layer, taking a lead integration role: managing the functional interfaces with of these systems; co-ordinating the user profiles and alarm strategies with the various sub-systems; and harmonising the human factors related to the user interfaces where required.
- 9.3.5 The EMS will include software interfaces of multiple types, including interfaces with programmable logic controller (PLC) and remote terminal unit (RTU) based systems, SCADA systems from multiple disciplines, building management systems, closed-circuit television, access control and intruder detection, CCS, network management systems, etc.
- 9.3.6 Most of these systems, including the EMS, will be physically located on HS2 premises and will be connected to the DTN. Others will be cloud-based and will lie outside the HS2 domain.
- 9.3.7 The Operational Telecommunications Contractor will provide DTN services related to time, user identification, domain control, etc.
- 9.3.8 The EMS Contractor will be required to take an active role supporting the integration of the EMS software interfaces with these DTN services, to ensure the correct configuration of the DTN and to allow secure data transmission in accordance with national security rules.
- 9.3.9 The EMS Contractor will not be required to provide field equipment, though software interfaces that permit interconnectivity with external systems will be needed. These software interfaces will be via secure open standards of communication and the EMS will be required to support these. Further details will be set out in the Works Information.

- 9.3.10 Some integration with external systems will require a ‘single sign on’ to enable seamless access to an external systems’ graphical user interfaces or development of applications to support interconnectivity (including development of Application Programming Interfaces and Software Development Kits).
- 9.3.11 Given the scale and nature of the HS2 environment, the quantity of input/output to be integrated is expected to include thousands of data points. The EMS system will be expected to be developed to accommodate this capacity.

9.4 System development and testing

- 9.4.1 The EMS will be required to have a software interface with numerous external systems, which will be available at various stages in the development programme. Consequently, the EMS Contractor will be required to build the EMS in its own premises, providing progressive assurance, testing and validation of controlled versions of the application software to support the HS2 delivery programme.
- 9.4.2 The EMS Contractor will be required to provide a laboratory with all the necessary equipment and tools to ensure progressive assurance of controlled versions of the system.
- 9.4.3 The EMS Contractor will also be required to build a simulation environment to enable efficient development, testing and validation of the EMS system. This will facilitate validation of the software tools employed to simulate interfaces with external systems provided by other contractors.
- 9.4.4 The EMS Contractor will be required to support the HS2 testing and commissioning programme by undertaking testing of its software interfaces via temporary networks, working with other system stakeholders, attending their premises, sites or testing laboratories as necessary.

9.5 System integration facility

- 9.5.1 To support integration and verification of system functionality and software interfaces, a SIF will be provided by HS2 Ltd. This will include a reference DTN and associated services and systems. The SIF will provide an opportunity for early integration of the EMS and other systems over temporary network infrastructure in a laboratory environment.
- 9.5.2 The EMS Contractor will be required to provide the necessary EMS hardware, software, testing environment, tools, spares and technical support to facilitate both

cyber security-related testing and normal integration demonstrations. Further details will be set out in the Works Information.

- 9.5.3 Where appropriate, the EMS Contractor will be required to make use of the SIF to verify versions of software before deployment in the real environment.

9.6 Interfaces with other contractors

- 9.6.1 The EMS Contractor will be required to work closely with other HS2 contractors to integrate multiple systems within the EMS platform to provide supervisory monitoring and control functionality and in some cases accessibility to remote GUI.

- 9.6.2 The following list (not exhaustive) provides an indication of the different type of systems and assets which will have to be integrated with the EMS. Further details of all these interfaces and integration with these systems for Phase One and 2a will be provided in the Works Information.

Track Systems

- track switches and crossings
- rail expansion devices

Tunnel M&E Systems

- tunnel ventilation control and related MEP (including coordination on the tunnel ventilation mode selection and passing fire events from the rolling stock)
- tunnel lighting control systems
- tunnel hydrant mains
- cross-passages doors, fire control panels and active signage
- pumping stations in tunnels
- public address voice alarm (PAVA) system for cross-passages
- cross-passage CCTV (including access to camera streaming)

Lineside M&E systems

- open route lighting systems
- open route drainage stations
- open route point heaters
- HVAC units in shafts, portals and REBs
- lighting control systems in shafts, portals and REBs
- fire control panels in shafts, portals and REBs
- pumping stations in shafts and portals
- uninterruptable power supplies (UPS)

Power Systems

- Traction power and overhead catenary systems
- Non traction HV/LV systems

Operational Telecommunications Systems

- network management system (NMS) (including network security)
- operational telephony system
- voice recording system
- tunnel radio system

Route wide security systems

- access control and intruder detection
- video surveillance (including access to specific camera streaming)

Command Control and Signalling

- supervisory monitoring of certain CCS infrastructure
- coordinated management of possessions and isolations

Weather Monitoring

- weather information

WWH Depot

- critical M&E assets
- building facilities in the NICC

Phase One Stations

- platform edge protection systems (platform screen doors (PSD) or similar) (where applicable)
- critical M&E systems in station critical rooms (e.g. signalling and communication rooms)
- CCTV related to train dispatch system (where applicable)
- emergency evacuation/fire alarms

Civil Infrastructure Monitoring

- critical events detected by the permanent civil infrastructure monitoring systems such as major deviations in the alignment of the permanent civil infrastructure (tunnel segments, viaducts, earthworks and flooding).

9.6.3 The HS2 rolling stock manufacturer will provide a centralised monitoring platform that communicates with the rolling units, known as the wayside data system (WDS), to enable supervisory monitoring of critical events detected by trains related to track

geometry, the OCS, balise detection systems or related to fire events onboard trains. The rolling stock manufacturer will provide a functional interface to the EMS to enable these events to be monitored and to allow the status of PSDs in stations to be reported back to the WDS for onward communication to rolling stock.

- 9.6.4 The EMS Contractor will also be expected to work with HS2 Ltd’s corporate IT contractor(s) to integrate the EMS with an HS2 corporate layer to enable asset information and analytical functions for business intelligence and decision support.

9.7 Maintenance and technical support services

- 9.7.1 The EMS Contractor will also be required to undertake maintenance of all equipment provided within this contract between the date of installation and take-over of the Works by the Employer.
- 9.7.2 The EMS Contractor will be required to provide ongoing technical support and spares supply to the maintainer, under a separate TSC for a minimum period of 12 years from Sectional Completion.
- 9.7.3 For the EMS systems, it is proposed that rapid response, Level 1 and Level 2 maintenance will be undertaken by HS2 Ltd (please refer to Table 4). This includes preventative and reactive maintenance. The EMS TSC will include Level 3 services (off-site and on-site support, provision of spares), training and obsolescence management (Level 4).
- 9.7.4 All software source code, hardware designs and specifications will be held in escrow.
- 9.7.5 Details of the scope of services included in the TSC and the arrangements for award of this contract will be made available with the Invitation to Tender for the EMS Contract.

10 Description of the Works – CCS and TM

10.1 Introduction

- 10.1.1 The CCS and TM Contractor will be responsible for the delivery of the Phase One and Phase 2a CCS and TM systems.
- 10.1.2 The CCS and TM Contractor will be responsible for the following Phase 2b works:
 - the extension of the Phase One / 2a TMS to cover Phase 2b; and
 - the CCS and TM works required for the Phase 2b alterations at Euston station including additional platforms.
- 10.1.3 The CCS and TM Contractor will be responsible for the provision of technical support services for the Phase One and Phase 2a CCS and TM systems.
- 10.1.4 The term “CCS System” is used in this document to describe all systems included within the CCS and TM scope.
- 10.1.5 Table 10 below contains indicative key data related to the CCS and TM contract.

Table 10 - CCS and TM Contract key data

Phase	Key data (approximate figures)
Phase One	469 single track km, including 250 bridges, 58 viaducts, 47 underbridges and 148 overbridges. Four stations: <ul style="list-style-type: none"> • Euston - six terminal platforms (increasing to 11 for Phase 2b); • Old Oak Common - six through platforms; • Birmingham Interchange - four through platforms; and • Curzon Street - seven terminal platforms. Six passing / maintenance loops/sidings and four complex track junctions. 131 point ends, including 99 high-speed turnouts (between 130km/h and 230 km/h), 32 low-medium speed turnouts (up to and including 100km/h), five traps or diamonds.
Phase 2a	60 km of double track railway, including 18 underbridges, 43 overbridges, four viaducts, two tunnels and one retained cutting. 24 point ends (130km/h) and 2 high-speed turnouts (230km/h).

10.1.6 The depot signalling and control systems at Washwood Heath RSMD and Calvert IMD are not included in the scope for the CCS and TM contract, although there will be an interface with these systems.

10.2 HS2 operational requirements

10.2.1 The CCS System will support the following operational requirements on the HS2 infrastructure:

- operational line speed of a maximum of 360 kph with varying line speeds along the route;
- 18 trains per hour in both directions without any interference between trains with a maximum of 120 second dwell time;
- technical headway of 120 seconds including station stops in both directions;
- bi-directional operation at the maximum permissible line speed; and
- identical operational capacity and functionality in the reverse direction as specified for the normal direction.

10.3 CCS and TM scope

10.3.1 The CCS and TM scope includes the design, manufacture, supply, installation, supervision, inspection, safety authorisation, testing, commissioning, maintenance until handover to trial operations and ongoing technical support services of the following:

- ETCS including all lineside equipment;
- signalling equipment including interlocking and train detection equipment;
- Automatic Train Operation (ATO) Grade of Automation 2 (GoA2) over ETCS;
- the Traffic Management System (TMS);
- the Enterprise Service Bus (ESB);
- the Possession Management System (PMS);
- the Adhesion Management System (AMS); and
- the Weather Monitoring System (WMS).

10.3.2 The CCS and TM Contractor will undertake the roles of Contractor and Designer under the Construction (Design and Management) Regulations 2015.

10.3.3 Delivery of the Global System for Mobile Communications - Railway (GSM-R) is not included within this contract however the CCS and TM Contractor will be responsible for leading integration for the overall CCS system including GSM-R. The GSM-R contractor will undertake safety authorisation for the GSM-R system.

10.3.4 The CCS and TM Contractor will be responsible for producing all of the required documentation for the authorisation of the overall CCS System including safe integration with the GSM-R and rolling stock systems.

10.4 Signalling

10.4.1 The trackside ETCS system will deliver Level 2 functionality (without signals) with Level 0 and Level 1 functionality where required.

10.4.2 A cost benefit analysis for the potential implementation of hybrid Level 3 functionality will be an early contract deliverable.

10.4.3 ETCS will be provided on all sidings, spurs, loops, tunnels, stations and open sections on the HS2 infrastructure.

10.4.4 ETCS functionality will be provided on the depot departure roads. The HS2 mainline signalling will interface with the depot signalling and control systems.

10.4.5 The CCS System will support safe and reliable train dispatch at stations.

10.4.6 Monitoring and maintenance controls for the CCS System will be available at the NICC.

10.4.7 The CCS System will permit safe and reliable operation in degraded modes including recovery of failed trains anywhere on HS2 infrastructure.

10.4.8 Trackside vehicle health monitoring equipment may be required, this will be confirmed in the Invitation to Tender documentation.

10.4.9 It is intended that keys for the HS2 ETCS trackside system will be provided by the Great Britain (GB) Key Management System (KMS). However, an online KMS compliant with the Transport Layer Security (TLS) - Public Key Infrastructure (PKI) solution may be required to be provided should the GB KMS not be available, this will be confirmed in the Invitation to Tender documentation.

10.5 Automatic Train Operation

10.5.1 ATO with GoA2 will be available on the HS2 route including sidings, spurs, loops and for the transition into Washwood Heath RSMD.

10.5.2 A single infrastructure geographic database common to the TMS, the ETCS and the ATO systems will be provided as part of the CCS System.

- 10.5.3 The data accuracy will be sufficient to support ATO operation.
- 10.5.4 In automatic mode, the trains’ stopping accuracy will be commensurate with platform edge doors applications.
- 10.5.5 The CCS System will enable two independently controlled 200m trains to use the same platform with ATO at all platforms.
- 10.5.6 ATO will support degraded and emergency modes including pull/push out functionality.
- 10.5.7 All passenger trains will operate under ATO but will also be capable of operating manually in degraded mode. Provision and fitment of the rolling stock onboard CCS equipment will be undertaken by others.
- 10.5.8 It is assumed that maintenance trains will not be fitted with ATO and will operate in ETCS Level 2.

10.6 Traffic management system

- 10.6.1 The main functionality of the TMS will include as a minimum:
- automatic train supervision and regulation including plan/replan functionality;
 - automatic platform re-allocation through a human machine interface (HMI);
 - reconfigurable control areas to manage operator workload during times of disruption (including integrated and dynamically assigned communications);
 - interfaces to third party stock and crew systems; and
 - interfaces to third party support tools for automatic incident management.
- 10.6.2 The TMS will provide timetable and contingency plan management, conflict identification and conflict decision support.
- 10.6.3 The TMS will provide outputs for real-time passenger information to support the delivery of the train service performance.
- 10.6.4 The TMS will dynamically adapt and optimise the plan using available information such as (but not limited to):
- weather conditions;
 - ticketing and loading data;
 - location and timing information of HS2 trains on HS2 infrastructure;

- location and timing information of HS2 trains on Network Rail managed infrastructure and on the HS2 managed depot lines; and
- data from the third party stock and crew allocation systems.

10.6.5 Speed restrictions will be entered only once and the data shared with other systems which require the information.

10.6.6 It will be possible to set speed restrictions automatically or manually for adverse infrastructure and / or weather conditions. Speed restrictions will not be removed automatically but only by manual operation.

10.6.7 The TMS will support the management of possessions and isolations.

10.7 Possession management system

10.7.1 The CCS System will include a method of taking possessions that permits the safe reservation/occupation of sections of the track for personnel and trains.

10.7.2 The PMS will ensure that the maximum time is made available for a safe and efficient method of work on HS2 infrastructure.

10.7.3 The PMS will provide a direct interface with the NICC for on-site maintenance personnel via a handheld smart device.

10.7.4 The PMS will use both local and remote protection measures to guarantee the safety of personnel and trains.

10.7.5 The PMS will permit and implement automated pre-planned possessions using the plan produced within the possession planning tool provided by others.

10.7.6 Engineering trains will be automatically stopped at the entrance to and exit from possession areas and worksites.

10.7.7 Isolated sections in the possession area will be displayed on the handheld smart device.

10.8 Weather monitoring system

10.8.1 The WMS will provide information about humidity, wind, temperature, snow/ice and lightning on the HS2 infrastructure.

10.8.2 The WMS will provide data to the CCS System to indicate areas of potential poor adhesion and/or where speed restrictions should be applied in the case of high winds.

10.8.3 The WMS will be capable of sharing gathered data with other HS2 asset management and business systems.

10.9 Adhesion management system

10.9.1 The AMS will provide automated and manually operated adhesion management via the TMS.

10.9.2 The AMS will use weather data provided by the WMS and feedback from trains about wheel slide events and applicable ATO braking rates.

10.9.3 The AMS will work concurrently with the trackside ATO equipment, and via this the train on-board equipment.

10.10 Enterprise service bus

10.10.1 The ESB will enable the NICC and other stakeholders’ systems to access and exchange common, real time status information for all trains and HS2 assets.

10.10.2 The ESB will implement a communication system between mutually interacting software applications in a service-oriented architecture (SOA).

10.10.3 The ESB will be configured to receive remote condition monitoring status and alarms from the CCS System.

10.11 NICC remote tap in facility

10.11.1 The CCS and TM Contractor will provide, install and commission the equipment associated with the remote tap in facility that supplements the NICC including all handover controls and procedures.

10.11.2 The remote tap in facility will be located within a fitted out HS2 Ltd building provided by others.

10.11.3 The remote tap in facility allows NICC staff to access NICC systems when the NICC building is unavailable but all systems within are working normally.

- 10.11.4 The CCS System will provide backup functionality permitting both automatic and manually controlled transitions between the primary and the backup equipment.
- 10.11.5 The CCS and TM Contractor may be required to provide CCS systems and interfaces at the remote tap in facility.

10.12 System integration facility

- 10.12.1 HS2 Ltd will provide a system integration facility to allow the offline proving of the relevant HS2 systems and support the integration of systems during development and delivery.
- 10.12.2 As part of the system integration facility, the CCS and TM Contractor will deliver a CCS integration laboratory specific to the CCS System and its interfaces.
- 10.12.3 The CCS integration laboratory will be located within a fitted out HS2 Ltd building provided by others.
- 10.12.4 The CCS and TM Contractor will provide all the required CCS System equipment and testing environment for the CCS integration laboratory.
- 10.12.5 The on-board CCS equipment and GSM-R equipment for the CCS integration laboratory will be provided by others.

10.13 Equipment at the NICC

- 10.13.1 The CCS and TM Contractor will provide, design, install and commission all equipment within the NICC for the CCS System including interfaces with the Train Manufacturer and Maintainer and other stakeholders’ systems.
- 10.13.2 The CCS and TM Contractor will provide workstations for the NICC operating control room.
- 10.13.3 For all relevant CCS System sub-systems, the CCS and TM Contractor will provide a simulation based training system for NICC operators and maintainers to support staff training, incident/failure scenario re-creation/investigation and ongoing competence management.
- 10.13.4 The CCS System training system will include instructors’ terminals with the ability to execute scenarios, monitor and manage student equipment and record events.

10.13.5 The CCS System training system will interface with other training systems provided by others.

10.14 Cabling and cable protection

10.14.1 The CCS and TM Contractor will be required to design, supply and install all data cabling from their equipment to a local DTN node provided by others.

10.14.2 The CCS and TM Contractor will be required to design, supply and install all power cabling from their equipment to a local distribution board provided by others.

10.15 Civil engineering works

10.15.1 The CCS and TM Contractor will design and provide all minor civil works required for the CCS System trackside equipment, concrete bases, ducting, equipment fixings, equipment housings and lineside buildings such as relocatable equipment buildings (REB's) where appropriate.

10.16 Interfaces

10.16.1 The CCS System will interface with numerous systems including internal and external interfaces.

10.16.2 The interfaces include those with other HS2 railway systems and assets (e.g. depot control and signalling systems) as well as external interfaces such as Network Rail or other stakeholders (e.g. West Coast Mainline systems).

10.16.3 The CCS System will be interfaced with the GB KMS.

10.16.4 An open interface will be provided between the TMS and other CCS systems to support integration with Phase Two infrastructure. The deliverables will include a royalty free unlimited use, and transferable licence, design documentation, any protocol libraries (including source code) used between the two systems and any protocol test harness (including source code) with associated instructions.

10.16.5 The CCS and TM Contractor will provide all Uninterruptable Power Supplies (UPS) necessary to achieve the required reliability and availability of the CCS System.

10.17 Maintenance and technical support services

- 10.17.1 The CCS and TM Contractor will provide maintenance of all equipment provided within this package between the date of installation and the date of handover to trial operations.
- 10.17.2 The CCS and TM Contractor will provide technical support during trial operations.
- 10.17.3 The CCS and TM Contractor will provide an ongoing technical support and spares supply service to the maintainer for a minimum period of 15 years.
- 10.17.4 The proposed maintenance levels for HS2 Ltd are described in Table 4 in 2.10.3.
- 10.17.5 For the CCS System, it is proposed that rapid response, level 1 and level 2 maintenance will be undertaken by HS2 Ltd. This comprises preventative and reactive maintenance.
- 10.17.6 The CCS and TM technical support contract will include the following level 3 and level 4 services:
- off-site support (level 3)
 - on-site support (level 3)
 - provision of spares (level 3)
 - training (level 4)
 - obsolescence management (level 4)
- 10.17.7 All software source code, hardware designs and specifications will be held in escrow. This requirement will be further defined in the Invitation to Tender documentation.

10.18 Compliance with legislation and standards

- 10.18.1 The CCS System will be in accordance with relevant European Directives, including TSIs, European and Industry Standards and HS2 Project Standards.
- 10.18.2 The CCS System will be in accordance with Railway Group Standards (RGS) and Railway Industry Standards (RIS) where required.
- 10.18.3 Where the Works are required to be undertaken on Network Rail controlled infrastructure the CCS and TM contractor will design and install these works in accordance with Network Rail standards and processes.

11 Description of the Works - Depot and NICC Contractor

11.1 Introduction

- 11.1.1 There will be one contract that includes the design, construction, testing and commissioning of the HS2 Rolling Stock Maintenance Depot and stabling sidings at Washwood Heath, Birmingham, together with the design, construction, testing and commissioning of the Network Integrated Control Centre (NICC) building, referred to in this section as the Depot and NICC Contract.
- 11.1.2 In the depot area, the Depot and NICC Contractor will be responsible for provision of all track, overhead catenary, power, M&E, local communications and control systems as well as the design and construction of depot buildings, building services and provision of depot plant.
- 11.1.3 The Depot and NICC Contractor will be responsible for design and construction of the NICC building, which will be used by HS2 Ltd for control of the high-speed infrastructure, but the scope does not include the installation, testing and commissioning of HS2 main line control and communication systems in the NICC.
- 11.1.4 The depot will be operated by the Train Manufacturer and Maintainer (TMM) and the West Coast Partner (WCP).
- 11.1.5 The depot and NICC will contain a number of systems and facilities that are to be specified by HS2 Ltd in conjunction with the WCP, TMM or Others. These are to be provided, tested and commissioned by the Depot and NICC Contractor, in conjunction with these stakeholders. In each case these stakeholders will require access to the relevant facilities in order to complete operational training or tests and the Contractor is required to support and co-ordinate this work, to facilitate timely completion and handover.
- 11.1.6 Table 11 below contains a summary of the key data related to this contract, with indicative quantities.

Table 11 - Depot and NICC Contract key data

Works Description	Key Data (Approximate)
Buildings	
Rolling stock maintenance building (including approximately 11 tracks and a wheel lathe building), stores, staff office and other accommodation.	40,000 m ² floor area
Cleaners’ and drivers’ building	2,000 m ² floor area
Automatic rail vehicle inspection building	1
Gatehouse	200 m ² floor area
Associated rolling stock maintenance specialist equipment, including gantry cranes.	As specified
Test track building	150 m ² floor area
Network Integrated Control Centre	6000 m ² floor area
External Works	
Track	24 km
Track drainage	24 km
OCS	20 km
S&C	63 units
Carriage wash machine (CWM)	1
Highways and walkways	130,000 m ²
Underpass	2 (stabling area and drivers’ access road)
Platforms and trackside walkways	18,000 m ²
Drainage	90,000 m ² (surface area)
External lighting	220,000 m ²
HV/LV distribution Including 3 non-traction substations	7,000 m
Security including permanent external fencing, access control (pedestrian)	4000 m
Car parking	1800 m ²
Landscaping and related works	As required
Utility connections	As required

11.2 Washwood Heath site

- 11.2.1 The Washwood Heath site is adjacent to the HS2 main line, between Delta Junction and Birmingham Curzon Street station. The site covers approximately 40 hectares. Figure 3 illustrates the layout of the depot.
- 11.2.2 The primary components (from left to right in the figure) are as follows:
- driver handover subway and platform on reception track
 - carriage washing machine (CWM) and automated vehicle inspection (AVI) facilities.
 - stabling sidings with access to the adjacent high-speed line
 - pedestrian subway for staff access to tracks
 - depot buildings, car parking and NICC building
 - TMM maintenance shed with adjacent parking and road access.
- 11.2.3 There is also development land to the south of the site, which will not be available to the Depot and NICC Contractor.
- 11.2.4 The MWCC will progressively hand over to the Depot and NICC Contractor a clear and level site. MWCC will complete all retaining walls and structures. Bulk earthworks or contaminated land remediation will not form a significant part of the Depot and NICC Contractor’s scope, unless changes to the depot layout result from Contractor’s design development.
- 11.2.5 Further details of the site area, planning and consents requirements, including Parliamentary Undertakings and Assurances and consents provisions that will become the responsibility of the Depot and NICC Contractor, access arrangements and responsibilities for safety and security will be set out in the Works Information.
- 11.2.6 HS2 Ltd is undertaking outline design for the Depot and NICC across the site, in order to demonstrate compliance with programme performance objectives, to support discussions with internal and external stakeholders.
- 11.2.7 The Depot and NICC Contractor will be expected to continue to develop this design, and to develop alternative proposals as necessary, taking full account of the requirements set out in the Works Information.
- 11.2.8 The Depot and NICC will be an exceptional working environment that promotes and enhances the health and wellbeing of in excess of 400 staff. The buildings will be of high architectural quality externally and internally and will be designed to meet high

standards of ergonomic performance to maximise the experience of operators and users.

11.2.9 All buildings, plant, systems and facilities on the Depot and NICC site will be expected to be designed in accordance with the HS2 Design Vision and Design Approaches documents, which call for the pursuit of excellence in important areas of their development.

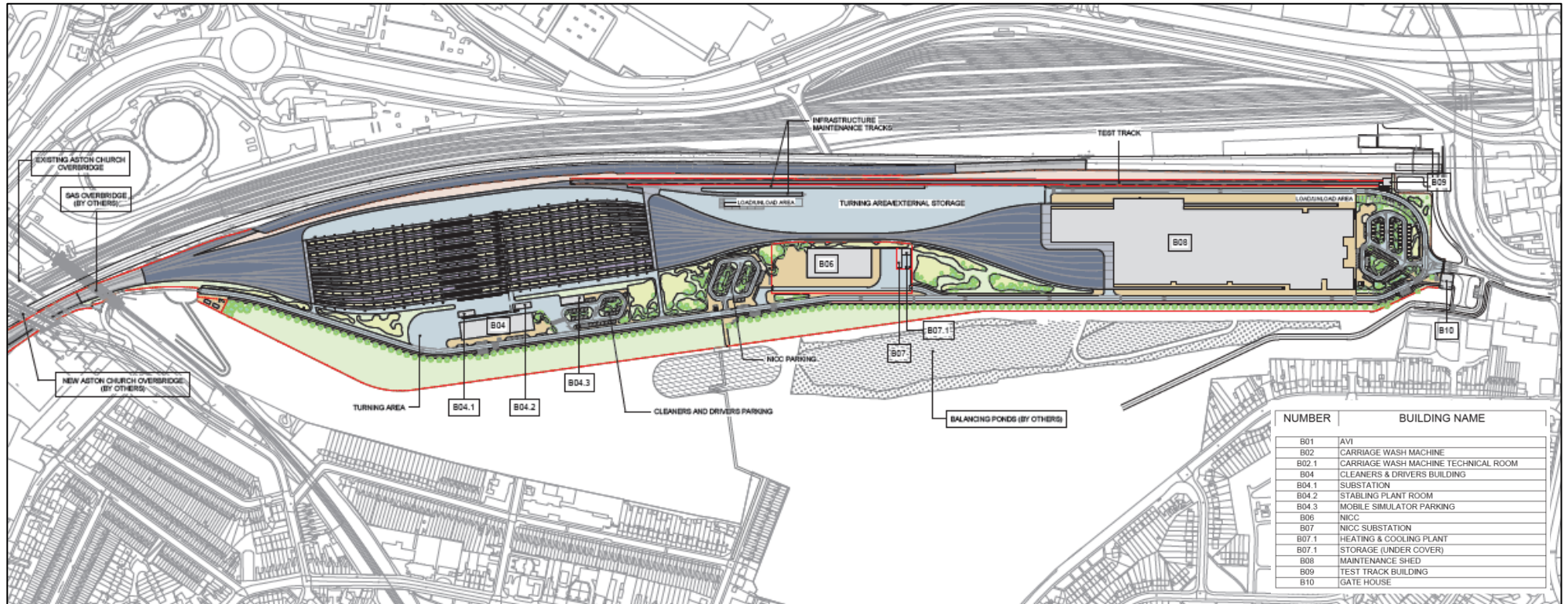
11.2.10 The Depot and NICC buildings are required to achieve a BREEAM Excellent Standard and to support the HS2 sustainability objectives, including carbon reduction targets.

Scope Document - 'Compendium Version' Railway Systems Contracts

Document no: HS2-HS2-SY-SPE-000-000014

Revision: P03

Figure 3 - Washwood Heath Depot and NICC



11.3 Depot – general requirements

- 11.3.1 The depot will be the primary maintenance and stabling facility for the HS2 train fleet and (at busiest times of the day) it is expected that up to 18 trains per hour will be leaving or arriving on the access tracks. The layout and control systems will be designed for a maximum speed of 25 km/h, except for on the arrival and departure tracks, which will be designed for 80 km/h.
- 11.3.2 The Depot and NICC Contractor will be responsible for the design, construction, testing and commissioning the railway systems in the depot, all of which will need to be compliant with HS2 standards and specifications and capable of supporting this volume, speed and frequency of traffic. The Depot and NICC Contractor will be obliged to demonstrate that the design has incorporated the HS2 Reliability, Availability, Maintainability and Safety (RAMS) requirements in their design.
- 11.3.3 The depot will comprise plain line track and S&C to create stabling and servicing sidings with associated platforms and walkways, that will provide depot staff with access for cleaning and servicing of rolling stock.
- 11.3.4 The depot layout and outline design information, including building layout information, key quantities and further system-specific data for pricing purposes, will be provided to the Contractor at tender stage.
- 11.3.5 The Depot and NICC Contractor will be responsible for design development and integration, supply, installation, testing and commissioning of all systems necessary to provide a fully-functional depot that meets HS2 Ltd’s requirements and specifications, details of which will be included in the Works Information.

11.4 Track systems

- 11.4.1 A track layout will be provided with the Invitation to Tender. The Depot and NICC Contractor will be responsible for developing the design, including selection of componentry that meet HS2 Ltd standards.
- 11.4.2 Ballasted track will be required within the depot. Pre-cast concrete and *in-situ* slab track may also be required.
- 11.4.3 The Depot and NICC Contractor will be responsible for providing S&C that is consistent with the speed and geometry of the operational depot and meets HS2 system performance and reliability requirements.
- 11.4.4 Points heating systems will also be required.

11.5 OCS, Power and M&E Systems

- 11.5.1 The Depot and NICC Contractor will be responsible for developing the 25 kV AC OCS design and most of the track layout (except designated HS2 infrastructure maintenance tracks) will be electrified and capable of electrical isolation from the mainline system.
- 11.5.2 The Depot and NICC Contractor will be responsible for developing the design of the 25 kV HV traction power system within the depot and the HV/LV non-traction power distribution system that serves the depot plant, equipment and buildings. These systems will take their primary HV traction and non-traction feeds from an Autotransformer Station (ATS) substation and an 11 kV or 33 kV HV substation respectively, that will be designed and installed by the HV Power Systems Contractor or Others.
- 11.5.3 HS2 Ltd will provide the Depot and NICC Contractor with the primary characteristics of the traction power supply, which will be capable of supporting train movements inside the depot as well as providing power to stationary rolling stock.
- 11.5.4 The power supply, bonding and earthing systems will be designed to facilitate remote isolation, controlled from the depot control centre, interlocked with the train control system. The Depot and NICC Contractor will be required to work with HS2 Ltd to develop a detailed isolation and maintenance strategy and to design the systems to facilitate separate isolation of individual tracks.
- 11.5.5 For critical systems within the depot, the Depot and NICC Contractor will be required to design, install, test and commission Uninterruptable Power Supplies (UPS) in accordance with HS2 specifications.
- 11.5.6 The Depot and NICC Contractor will be required to design, install, test and commission all M&E systems, including lighting throughout the depot.
- 11.5.7 The Depot and NICC Contractor will design, install, test and commission all the utilities services for the depot and will undertake all connections to the local utility networks (sewage, drainage, water, communications). The Depot and NICC Contractor’s scope will include all surface and sub-surface drainage, pumping systems and interceptors. Connections to balancing ponds and the ponds themselves will be provided by Others.

11.6 Control systems

- 11.6.1 The HS2 Ltd main line train control will be ERTMS, comprising ETCS and GSM-R, with ATO. This train control system will be controlled by the NICC. These systems will be provided by the CCS and TM Contractor.
- 11.6.2 The Depot and NICC Contractor will be required to work with HS2 Ltd and the Operational Telecommunications Contractor to facilitate GSM-R coverage within the depot, including supporting infrastructure.
- 11.6.3 The Depot and NICC Contractor will provide a train control and depot signalling system, including a separate control centre, housed within the Maintenance Building (not at the NICC), to manage all depot train movements, extending to an agreed transition point with the main line train control system.
- 11.6.4 The depot control centre will also include the systems for the control of traction power, catenary isolation, M&E systems and other infrastructure systems.
- 11.6.5 Details of functional requirements, including the need for depot staff protection arrangements, will be included in the Works Information.
- 11.6.6 The Depot and NICC Contractor will be responsible for a local voice communication system for use by depot staff and for a communication system between the control centre and train operating staff, to be used to receive trains from the main line and during train movements within the depot. Both systems will be required to contain the necessary safety and security provisions, in accordance with HS2 standards.
- 11.6.7 A DTN communications backbone will be required to facilitate communications throughout the depot.

11.7 Other systems

- 11.7.1 There will be a specially equipped track within the depot to test rolling stock systems. The Depot and NICC Contractor will be responsible for the installation of track, OCS and facilities for test track staff accommodation and for control of the test track systems. The Contractor will need to work with HS2 Ltd and Others to agree the specification of the test track. The test track may also be equipped with systems such as CCS equipment, that are designed, supplied and installed by the CCS and TM Contractor, working in collaboration with the Depot and NICC Contractor.
- 11.7.2 An appropriate cable management system, and suitable anti-slip walking routes for staff will be required throughout the depot.

- 11.7.3 The Depot and NICC Contractor will be responsible for hard and soft landscaping, car parking, physical security, including fencing, gates and CCTV system. The depot will require car parking facilities for staff and visitors in multiple locations. Access will be designed to support all types of licensed road vehicles, including mobile cranes and 44-tonne heavy goods vehicles.

11.8 Depot buildings

- 11.8.1 Within the depot, there are a number of buildings that the Depot and NICC Contractor will be required to design, construct, equip and fit-out, including testing and commission of building services, control systems and specialist equipment.
- 11.8.2 The Depot and NICC Contractor will be required to provide foundations, substructure, superstructure, cladding, lighting, acoustics, heating, ventilation, drainage connections, power connections, other utility connections, building management systems, building security, welfare and domestic provisions
- 11.8.3 The largest building is the Rolling stock Maintenance Building, which contains tracks for inspection and maintenance, bogie / equipment-drop and heavy-lifting. This building will be used by the TMM to maintain the HS2 rolling stock.
- 11.8.4 The Depot and NICC Contractor will provide equipment for the future use of the TMM, including gantry cranes, access gantries, maintenance pits, heavy lift and equipment drop facilities as well as equipment for activities such as windscreen changing. These systems will be provided, tested and commissioned by the Depot and NICC Contractor, working with HS2 Ltd and the TMM.
- 11.8.5 The Depot and NICC Contractor will also be required to provide railway systems equipment within this maintenance building. Each track will be fitted with OCS, which is likely to be a rigid beam design and the building will have a pantograph test facility. These systems will be provided, tested and commissioned by the Depot and NICC Contractor in conjunction with HS2 Ltd and the TMM.
- 11.8.6 The Depot and NICC Contractor will provide all other M&E systems specified in the Works Information,
- 11.8.7 The Maintenance Building will also contain the TMM offices and a number of workshops and areas for materials and tool storage, all of which will be provided by the Depot and NICC Contractor.

11.8.8 The Depot and NICC Contractor will be required to provide a Drivers and Cleaners Building, which is for use by the TMM and WCP. This will include appropriate office and welfare facilities, store and training facilities, including simulators designed, supplied and commissioned by Others.

11.9 Other depot facilities

11.9.1 There are other smaller buildings and facilities that will be provided by the Depot and NICC Contractor and specified by HS2 Ltd in conjunction with the TMM.

11.9.2 AVI facilities will be provided by the TMM. The Depot and NICC Contractor will be required to design and construct a suitable covered building in accordance with the constraints set out in the Works information.

11.9.3 The Depot and NICC Contractor will supply a double-track CWM with capacity to simultaneously wash two, 400m trains.

11.9.4 The Depot and NICC Contractor will also provide separate heavy-cleaning facility, including suitable biohazard systems that will be required on two of the depot tracks.

11.9.5 Bio-reactor toilet emptying facilities are to be provided by the Depot and NICC Contractor in two of the stabling sidings and in the heavy clean facility.

11.9.6 A minimum of one tandem wheel lathe (also known as an underfloor wheel lathe) will be provided by the Depot and NICC Contractor, with an associated gantry crane.

11.9.7 A security control facility and gatehouse will be required, for use by the security staff, to manage entry and exit from the Depot and the NICC site.

11.10 Network Integrated Control Centre

11.10.1 The NICC will be a stand-alone building within the WWH depot site, designed to accommodate important operational and management functions.

11.10.2 Rooms and facilities will be required, including high and lower security-clearance reception/waiting areas, meeting rooms, welfare facilities, specialist security and incident rooms, technical, plant and equipment rooms, stores, faith rooms and a significant operational control room (OCR), all of which will require specialist design contributions and building services design in order to meet HS2 Ltd requirements.

- 11.10.3 The Depot and NICC Contractor will be provided with initial design information and HS2 Ltd requirements but will be responsible for design development and subsequent construction, testing and commissioning of the building and systems.
- 11.10.4 In addition to building infrastructure, such as foundations, substructure, superstructure, cladding, lighting, acoustics, heating, ventilation, drainage connections, power connections, the Depot and NICC Contractor will be responsible for design, installation, testing and commissioning of all building services including HVAC, WIFI, security systems, video surveillance system (VSS), access control, building IT systems and fire suppression systems.
- 11.10.5 Protection of the OCR in the event of fire, flooding, and terrorist attack is of paramount importance. The building will have to be located, oriented and designed to prevent and minimise the impact of terrorist attack, fire, flooding and freak weather events in order that the HS2 network is able to continue operations.
- 11.10.6 The Depot and NICC Contractor will not be responsible for the design, installation, testing and commissioning of main line high-speed infrastructure control systems, which will be designed, constructed, tested and commissioned by other Railway Systems Contractors, but will have to take the requirements of these facilities into account when designing the building and act as the co-ordinator of others contractors from a CDM Principal Contractor’s perspective, during construction, testing and commissioning of main line systems.

11.11 Maintenance and technical support contracts

- 11.11.1 The Contractor may also be required to undertake temporary operation and maintenance of the railway systems in the depot after commissioning, including making systems and facilities available to support the installation and testing of HS2 rolling stock and other railway systems. These maintenance and operational arrangements will continue until an agreed final handover to HS2 Ltd and the TMM. Further programme details and information related to taking over of the site by the Employer will be set out in the Works Information and Contract Data.
- 11.11.2 The Depot and NICC Contractor will also be required to work with HS2 Ltd to procure future maintenance or technical support from original equipment manufacturers and specialist suppliers.

Appendix 1 Acronyms

Acronym	Definition
ACS	access control system
AFC	approved for construction
AMS	adhesion management system
ATO	automatic train operation
ATS	autotransformer sites
ATFS	autotransformer feeder stations
AVI	automated vehicle inspection
BEC	buried earth conductor
BIM	building information modelling
BREEAM	Building Research Establishment Environmental Assessment Methodology
BTS	base transmission stations
CCS	control, command, signalling
CPD	cross-passage doors
CRN	Conventional Rail Network
CSM	common safety method
CWM	carriage washing machine
DAS	distributed antenna system
DHCP	dynamic host configuration protocol
DNO	Distribution Network Operator
DNS	domain name system
DTN	data transmission network
EMS	Engineering Management System
ERTMS	European railway traffic management system
ESB	enterprise service bus
ESN	emergency services network
ETCS	European train control system
EU	European Union
EWC	Enabling Works Contracts

Acronym	Definition
FON	fibre-optic network
FPL	frost protection layer
FTN-X	fixed transmission network
GB	Great Britain
GoA2	Grade of Automation level 2
GPRS	general packet radio services
GSM-R	global system for mobile communications-railway
GSP	grid supply point
GUI	graphical user interface
HBL	hydraulically-bound layer
HMI	human machine interface
HS2	High Speed Two
HV	high voltage
HVAC	heating, ventilation and air conditioning
IMB-R	infrastructure maintenance base
IMD	infrastructure maintenance depot
IP	internet protocol
ITT	Invitation to Tender
KMS	key management system
LV	low voltage
LVDP	low voltage distribution panel
LWR	long-welded rail
M&E	mechanical and electrical
MEP	mechanical and electrical plant
MEPH	mechanical, electrical and public health
MGPTA	million gross tonnes per annum
MNO	mobile network operator
MPATS	mid-point autotransformer sites
MWCC	Main Works Civils Contractor
NG	National Grid

Acronym	Definition
NICC	network integrated control centre
NMS	network management system
NTPS	non-traction power system
O&M	operations and maintenance
OCS	overhead catenary system
OCR	operational control room
OEM	original equipment manufacturer
OTS	operational telephony system
PAVA	public address voice alarm
PBX	private branch exchange
PC	Principal Contractor
PIDS	perimeter intrusion detection system
PKI	public key infrastructure
PMA	project master alignment
PMS	possession management system
PQP	pre-qualification pack
PLC	programmable logic controller
PRAMS	performance, reliability, availability, maintainability and safety
PSD	platform screen doors
PSIM	physical security information management system
RADIUS	remote authentication dial-in user service
REB	relocatable equipment buildings
RED	rail expansion device
RF	Radio Frequency
RGS	Railway Group Standards
RIS	Railway Industry Standards
RSC	railway systems compounds
RSMD	rolling stock maintenance depot
RTU	remote terminal unit
S&C	switches and crossings

Acronym	Definition
SDN	station data network
SIEM	security information and event management
SIF	system integration facility
SME	small and medium-sized enterprises
SOA	service-oriented architecture
T&C	testing and commissioning
TDAS	tunnel distributed antenna system
TLS	transport layer security
TM	traffic management
TMM	train manufacturer and maintainer
TMS	traffic management system
TPS	traction power system
TRS	tunnel radio system
TS	tunnel system
TSC	technical support contract
TSI	technical specification for interoperability
TSI-SRT	safety in railway tunnels technical specification for interoperability
UK	United Kingdom
UPS	uninterruptible power supply
UTC	coordinated universal time
VMS	video management system
VSS	video surveillance system
WDS	wayside data system
WLVfM	whole life value for money
WMS	weather monitoring system

Appendix 2 Revision history

Version	Clause	Change
P01	1.1.2	Removed reference to “PQP”.
P01	1.4.7	Inserted description of porous portals used in the design of many of the tunnels into section 1 which had previously been issued in the scope descriptions of HRS23 CCS and TM and HRS13-18 Track Systems
P01	3.2.18	Updated Track Systems Contractor scope to remove the installation of lineside controllers housed in S&C interface cubicles.
P02	Preface	Table i. Addition of statement to the HRS12 OCS row stating that there will be two separate contracts awarded to one Contractor.
P02	1.1	Addition of term Candidate at 1.1.1 and 1.1.3
P02	Table 1	Addition of statement to the HRS12 OCS row stating that there will be two separate contracts awarded to one Contractor.
P02	4.1	4.1.1, 4.1.4 and Table 6: Addition of statement to the HRS12 OCS row stating that there will be two separate contracts awarded to one Contractor.