SCHEDULE 4

Project Management, Design, "RAMS", Testing, Site Management, Quality Assurance and Compliance Audit, Variations and Suspensions

1. PROJECT MANAGEMENT

1.1 PROJECT MANAGER

1.1.1 Save to the extent that notice in writing is given to the Contractor from time to time the Project Manager shall have full authority to act on behalf of the Company for the purposes of this Contract and the Contractor shall look to the Project Manager in all matters as if the Project Manager were the Company.

1.1.2 This Contract by virtue of its length and the scope of the required work shall be divided into an initial implementation phase (from the date of this Contract to the Final Acceptance of Delivery Date) and the service contract phase (from the Final Acceptance of Delivery Date for the remainder of the Contract Duration). The person appointed as Project Manager will change as this Contract moves from the delivery and installation phase to the service provision phase, when the Company shall appoint a Fleet Contract Manager. The Company will advise the Contractor of the date of such handover of responsibilities and as of such date the Fleet Contract Manager shall assume the power and responsibilities of the Project Manager.

1.1.3 The Project Manager may from time to time as he sees fit delegate any of the powers, functions and authorities vested in him to an assistant or assistants or agent and may at any time revoke any such delegation. Any such delegation or revocation shall be in writing signed by the Project Manager and shall state which power, function or authority is thereby delegated or revoked and the person or persons to whom or from whom the same are delegated or revoked respectively. No such delegation or revocation shall have effect until the Contractor receives it in writing.

1.1.4 The Contractor shall take instruction and/or direction given in relation to this Contract only from the Project Manager, his assistant, assistants or agents and shall comply with, and adhere strictly to, such instruction and direction on any such matters. If the Contractor so requires, such instructions shall be confirmed in writing within 5 Working Days.

1.1.5 Any instruction given by the Project Manager shall be binding on the Contractor and on the Company. Except where otherwise provided in this Contract or where the Project Manager is entitled under this Contract to give such instructions, instructions of the Project Manager relating to matters outside the scope of the work of this Contract (or reasonably to be inferred from the requirements of this Contract) which would, if complied with, cause the Contractor to incur additional cost or claim an extension of time shall be issued under the variation procedure set out in paragraph 8.

1.1.6 The Project Manager shall be entitled at all reasonable times during the manufacture of the Trains and Equipment and the carrying out of the Enabling Works to inspect, examine and require the Contractor to test on the Contractor's premises or elsewhere the materials and workmanship of plant, components or other parts to be incorporated or forming part of the Trains and Equipment and if any part is being manufactured on other premises the Contractor shall obtain for the Project Manager permission to inspect, examine and require testing of the relevant part. Such inspection, examination or required testing, if carried out, shall not absolve or release the Contractor from any of its duties and obligations under this Contract.

1.1.7 The Project Manager shall at all times have access to the Depots, the Outstations, Sidings and the Accommodation Properties in accordance with the terms of this Contract and the Real Property Documents and, at all reasonable times during the Delivery Period, to all workshops and places where work is being undertaken or

when materials, manufactured articles and machinery are being obtained for this Contract, and the Contractor shall afford every facility for, and every assistance in, obtaining such access or the right to such access.

1.1.8 In addition to the foregoing, the Contractor should note that the Company's chief engineer has authority to prevent or limit the use of the Existing Trains or Trains or Equipment or to impose special conditions. Such instructions will be transmitted through the Project Manager and the Contractor shall comply with these instructions within defined timescales. Any exercise by the Company's chief engineer of his authority under this paragraph 1.1.8 shall take effect in accordance with the variation procedure set out in paragraph 8.

1.1.9 It is a Company requirement that recommendations arising from Incident Investigation Reports and Senior Management Reviews shall, where relevant, be implemented on all Company lines and the Contractor will be required, in accordance with the variation procedure set out in paragraph 8, to incorporate any such recommendations into its operations and practices in respect of its obligations under this Contract. Such instructions will be transmitted through the Project Manager and the Contractor shall comply with these instructions within defined timescales.

1.1.10 The Project Manager may undertake audits on the Trains, the Existing Trains and the Equipment, the Enabling Works and Depot maintenance carried out by the Contractor.

1.1.11 The Contractor shall during the Delivery Period provide office accommodation and any other facilities reasonably required by the Project Manager at its premises where the Trains or the Equipment are being assembled or tested for the use by the Project Manager. The extent of office accommodation and such other facilities is to be agreed with the Project Manager.

1.2 CONTRACTOR'S REPRESENTATIVE

1.2.1 The Contractor shall appoint a competent Contract Manager authorised by the Contractor with full power and authority to make decisions and bind the Contractor in the carrying out of this Contract on behalf of the Contractor. The Contract Manager shall be empowered to receive, on behalf of the Contractor, directions and instruction from the Project Manager in relation to this Contract. Except in cases of emergency or where such notice is not possible, a minimum of three months' notice must be given to the Project Manager of a proposal to replace the Contract Manager and, before appointment of the replacement, the Project Manager shall have the opportunity to interview and approve the appointment of the replacement Contract Manager before the appointment takes effect.

1.2.2 The Contractor shall employ one or more competent representatives whose name or names shall have previously been communicated in writing to the Project Manager to superintend the carrying out of this Contract. The said representative, or, if more than one shall be employed, then one of such representatives shall be present whilst the Contractor is working on the Site and any orders or instructions in connection with the work being carried out by the Contractor on the Site which the Project Manager may give in writing to the said representative of the Contractor shall be deemed to have been given to the Contractor.

1.3 CONTRACT PLAN

1.3.1 Within 2 weeks of the date of this Contract, the Contractor shall submit a detailed Contract plan to the Project Manager in hard copy and in electronic form (floppy disk). This plan shall demonstrate that proper consideration has been given to the management of the Contract to the satisfaction of the Project Manager, using Artemis 7000 planning package or a suitable agreed alternative. The Contract plan shall not amend or seek to amend any Train Milestone Date, Train Delivery Target

Date or Target Completion Date set out in Schedule 5. If the plan is satisfactory to the Project Manager it shall be incorporated into the Contract as the Contract Programme. The Company shall not be responsible for any costs or charges associated with delay in the achievement of the Train Milestone Dates, the Train Target Delivery Dates or the Target Completion Dates arising from any inconsistencies in the logic content or otherwise of the Contract plan. The Contract plan submitted to the Project Manager shall take into account the Target Completion Dates. The Contract plan shall comprise the items identified in paragraphs 1.3.1.1 to 1.3.1.6 of this Schedule.

1.3.1.1 A summary programme which shall cover all aspects of the Contract and:

(a) list all major activities including design, placing of orders and sub-contracts, manufacturing, procurement, testing and commissioning, Depot take-over (in accordance with Schedule 12) and equipping from the date of this Contract up to the Final Acceptance of Delivery Date;

(b) be presented in an easily read form, with start and completion dates for each activity unambiguously stated and a list of the relationship of activities to each other; and

(c) be arranged so that the Train Milestone Dates, the Train Target Delivery Dates and Target Completion Dates are clearly defined at the end of activities against which the progress of work can be monitored.

1.3.1.2 The Contractor shall ensure that detailed programmes shall be provided which shall:

(a) contain details for each activity in the summary programme;

(b) show the submission and review periods of all documents requiring review by the Project Manager;

(c) clearly identify the Contractor's own safety and quality audits;

(d) indicate the requirements for Engineer's Trains and line Possessions;

(e) clearly indicate Train Milestone Dates, Train Target Delivery Dates and the Target Completion Dates;

(f) clearly indicate start and finish dates, duration and total float for each activity; and

(g) for all elements of the work, be in sufficient detail to enable progress to be monitored, to the satisfaction of the Project Manager, whether work is being or has been carried out by the Contractor or its sub-contractor, and shall identify whether the work is being carried out by the Contractor or by a sub-contractor in accordance with such programme and/or this Contract.

1.3.1.3 Network diagrams (precedence method) which shall:

(a) clearly indicate activity, number, description, start and finish dates, duration and total float, and constraints (logic links) between activities indicating the type (FS, FF etc.) and value (lead time) if any;

(b) clearly indicate Train Milestone Dates, Train Target Delivery Dates and the Target Completion Dates together with the appropriate logic links to the relevant activities; and

(c) clearly identify critical and sub-critical paths.

1.3.1.4 Manpower histograms indicating the requirements for engineering and design, manufacturing, testing and site personnel against a time scale of weekly

intervals and requirements for Engineer's Trains presented in graphical form, indicating the number each week.

1.3.1.5 Delivery of major items of Train equipment/systems, after the initial deliveries, shall be presented as a graph, i.e. number required against a time-scale, for each type of major item.

1.3.1.6 Details of the Contractor's organisational structure and the key people involved with this Contract including reporting lines and delegated authorities.

1.3.2 The Contract plan shall be reviewed by the Project Manager and upon acceptance it will be the baseline against which progress will be monitored. The Contractor shall not amend the base line without the prior consent of the Project Manager.

1.3.3 The Contractor shall demonstrate that the detailed programme is under control by use of critical path techniques to the satisfaction of the Project Manager. All critical and sub-critical paths shall be shown on the detailed programme. Actions taken on the critical and sub-critical paths shall be fully explained and demonstrated to the satisfaction of the Project Manager.

1.3.4 The Contractor shall give the Project Manager reasonable access on a read only basis to the Contractor's project management system as soon as possible and in any event within three Working Days of a request for such access. Such access will be under the supervision of the Contract Manager or its nominee.

1.3.5 The Contractor shall submit sub-contractors'/suppliers' programmes to the Project Manager on an as requested basis.

1.3.6 The documents listed in the following provisions of this paragraph 1.3.6 shall be updated every four weeks from a date specified by the Project Manager. The

updated information shall be submitted to the Project Manager in hard copy and electronic formats within five Working Days of the end of each four week period. The reporting periods shall be defined by the Project Manager at the beginning of each calendar year.

1.3.6.1 The summary and detailed programme referred to in paragraphs 1.3.1.1 and 1.3.1.2 of this Schedule respectively, required by the Project Manager together with an explanation of any changes to the programme (logic, durations, additions etc.). During this update the Contractor shall show for each activity (on the summary and detailed programme) the percentage completion, actual/forecast start and actual/forecast finish, remaining duration, total float and period variance against the base line (double line bar-chart).

1.3.6.2 Train Milestone Dates, Train Target Delivery Dates and Target Completion Dates which shall be derived from the detailed programme and presented in tabular form indicating, for each Train Milestone Date and Target Completion Date description, base line date, forecast/actual date, variance from the base line and variance during the reporting period.

1.3.6.3 An exception milestone report which shall be prepared in tabular form, indicating those Train Milestone Dates, Train Target Delivery Dates or Target Completion Dates where there has been a variance during the reporting period. For each Train Milestone Date, Train Target Delivery Date and Target Completion Date on this report the Contractor shall indicate base line date, forecast date, variance from the base line, variance during the reporting period, impact on the project, reason for period variance and steps taken to retrieve and/or avoid further slippage.

1.3.6.4 The manpower histograms and requirements for Engineer's Trains for the transport of materials and/or personnel shall be updated to show actual usage and forecast against the baseline.

1.3.6.5 Graphs for the delivery of major items of Train equipment and systems shall also be updated to show actual and forecast against the baseline.

1.3.7 The network logic diagrams will not normally be required to be submitted with each update. These documents will only be submitted on request by the Project Manager, circa every three to four months or whenever significant programme changes take place.

1.3.8 In order to allow proper interfacing of Site activities with other contracts and the running of the Northern Line, the Contractor will be required to produce detailed day to day programmes for its Site activities. Two months prior to commencement of any Site activity, the Contractor shall submit for review by the Project Manager a detailed Site programme for the particular area of work. This programme shall be prepared using critical path techniques and updated every week. No Site activity will be allowed to commence without approved installation documentation, including but not limited to, approved detailed Site programme method statement, inspection and test plans, installation drawings.

1.4 MANAGEMENT COMMUNICATIONS

1.4.1.1 All written communication shall be addressed to the Project Manager or Contract Manager as appropriate, shall be made in accordance with Clause 46 and shall take the form of letter, certificate, telefax, advice of delivery of equipment, drawings, microfilm, software (with a reference hard copy letter), or minutes of meetings.

1.4.1.2 The Contractor shall establish procedures to the satisfaction of the Project Manager for managing sub-contractors including the organisation of work and communication between the Contractor and its sub-contractors.

1.5 CONTROL OF COMMUNICATIONS, INFORMATION AND DOCUMENTS

1.5.1 The Contractor shall agree and use a logical and structured system for correspondence reference and drawing reference. All communications which do or might materially affect this Contract between the Contractor and the Company shall be given a unique number which must be revised in accordance with a quality approved change process if it is changed in any way. The Contractor shall maintain a log of all uniquely numbered correspondence for periodic inspection by the Project Manager.

1.5.2 All communications shall be acknowledged by the recipient within 5 Working Days of receipt thereof.

1.6 MEETINGS AND SUB-CONTRACTOR MEETINGS

1.6.1 All meetings between the Contractor and the Company shall be minuted and the minutes shall be published within 10 Working Days of the meeting.

1.6.2 The Contractor shall ensure that its representatives at all meetings with the Company have delegated power and authority to act on behalf of the Contractor.

1.6.3 The Project Manager shall have the right to instruct the Contractor to bring a representative of its sub-contractors to meetings and if so instructed the Contractor shall use its best endeavours to comply with that instruction.

1.6.4 The Contractor shall hold regular meetings with its sub-contractors with the same aims as those described in paragraph 1.6.7 of this Schedule. The Project Manager shall have the right to attend such meetings and shall be given reasonable notice of the dates of such meetings.

1.6.5 The Project Manager shall have the right to instruct the Contractor to convene a meeting between the Contractor and any of its sub-contractors which the Project Manager shall have the right to attend.

1.6.6 The meetings referred to in paragraph 1.6.7 shall be required as a minimum.

1.6.7.1 Project review meetings: to be held at four weekly intervals or as deemed necessary by the Project Manager from the date of this Contract until the Final Acceptance of Delivery Date. The project review meetings shall review:

(a) accuracy of previous minutes;

(b) minutes of design scrutiny meetings;

(c) progress against Contract programme and of attribution of delays in accordance with paragraph 1.7;

(d) critical paths and sub-critical paths;

(e) notes of any special meetings;

(f) quality;

(g) safety;

(h) identification of matters in dispute and actions towards resolution; and

(i) other matters as may from time to time be determined to be necessary by the Project Manager.

The Contractor shall submit a progress report to each project review meeting together with evidence of achievement of the Train Milestone Dates, Train Target Delivery Dates and Target Completion Dates or progress toward achievement of such dates. The report and the evidence shall be in a format required by and to the satisfaction of the Project Manager.

The Project Manager shall minute such meetings.

1.6.7.2 Design scrutiny meetings: to be held at four weekly intervals or more frequently if deemed necessary by the Project Manager from the date of this Contract until the date of issue of a Take Over Certificate for the First Train or such later date as deemed necessary by the Project Manager. Such meetings shall be held at the Project Manager's office unless the Project Manager agrees otherwise. The meetings will be chaired by the Project Manager or his representative and shall:

(a) review the accuracy of previous minutes;

(b) review the notes of meetings which discuss design proposals for any aspect of the project, particularly for equipment being specially developed for the Trains;

(c) monitor the programme for submission of documents for scrutiny;

(d) monitor the documents submitted for scrutiny since the previous meeting;

(e) monitor the comments made by the Project Manager of the documents submitted for scrutiny;

(f) discuss and identify areas for future design scrutiny as deemed necessary by the Project Manager;

(g) identify areas of the design where clarification of Schedule 6 is required;

(h) list and review any changes to the Materials Inventory since the previous meeting;

(i) review the latest performance related requirements of the Contract;

(j) review progress and results of the safety and reliability assessment programme;

(k) monitor the Contractor's safety and quality and other design plans;

(l) review progress of trials, test rigs, etc;

(m) review the testing programme;

(n) review joint sub-contractor design meeting notes; and

(o) determine courses of action related to the above subject matter required by the Project Manager.

The conclusions reached in the meeting and actions upon the Project Manager or the Contractor shall be recorded on a form to be drawn up by the Project Manager and signed by the chair person of this meeting and the Contractor's representative present.

Exchange of information between design scrutiny meetings is permitted. However, any actions agreed must be properly recorded and signed off at the next design scrutiny meeting.

The Project Manager may require that separate design scrutiny meetings are held for each particular engineering discipline (e.g. Trains, CCTV, Radio etc.).

1.6.7.3 Service performance meetings: to be held at four weekly intervals or as deemed necessary by the Project Manager from the Transfer Date (or such earlier date as is determined by the Project Manager) for the Contract Duration. Such meetings shall review:

(a) the accuracy of the minutes of the previous meeting;

(b) safety (in relation to, inter alia, the Properties and working practices) (this shall include the presentation by the Contractor of summary data of incidents including trend analyses);

(c) Trains, Existing Trains, Equipment and Enabling Works safety irregularities;

(d) Service Performance Failures of Trains and Existing Trains, and Equipment and Enabling Works failures and the allocation of responsibility;

(e) the Contractor's performance of this Contract;

(f) adjustments to Existing Train Service Payments and Usage Payments and payment dates;

(g) changes to maintenance standards, schedules and procedures;

(h) audit results;

(i) modifications to the Trains and Existing Trains;

(j) modifications to Equipment;

(k) modifications to the Enabling Works;

(l) disposal issues;

(m) identification of matters in dispute and actions towards resolution; and

(n) items of concern to either party.

In addition more frequent meetings shall be held as necessary to review the detail of individual failures or issues.

1.6.7.4 Variation/concession meetings: to be held at intervals as deemed appropriate by the Project Manager from the date of this Contract for the Contract Duration. Such meetings shall:

(a) review the accuracy of previous minutes;

(b) review the progress of decisions on variations and concessions;

(c) determination of impact on programme and or costs; and

(d) authorisation of Variations and concessions.

1.6.8 In addition to the meetings detailed in paragraph 1.6.7.3 of this Schedule the Contractor shall attend any other meeting as required by the Project Manager.

1.6.9 The Project Manager shall, at his discretion, be permitted to deal with any of the matters referred to in paragraph 1.6.7 outside the forum of any of the meetings referred to in such paragraph.

1.7 ALLOCATION OF RESPONSIBILITY FOR FINANCIAL CONSEQUENCES OF DELAYS

1.7.1 Whenever the Project Manager issues a Take Over Certificate or a Qualified Take Over Certificate in respect of a Train it is necessary for the Company and the Contractor to agree:

(a) whether such Certificate was issued on, by or after the relative Train Milestone Date as set out in paragraph 1.2 of Schedule 5 and, for the purposes of this paragraph 1.7, all references to the ***relative Train Milestone Date*** shall be deemed to disregard the effect of any extensions thereto in accordance with Clause 12 or the variation procedure set out in paragraph 8; and

(b) if such Certificate was issued after the relative Train Milestone Date (a ***Late Train***):

(i) the total number of days of delay in the Late Train receiving such Certificate; and

(ii) the number of days of delay for the financial consequences of which the Company is responsible; and

(iii) the number of days of delay for the financial consequences of which the Contractor is responsible.

1.7.2. At each 4 weekly project review meeting held in accordance with paragraph 1.6.7.1 the parties shall agree and minute as follows:

(a) whether any Train that received a Take Over Certificate or a Qualified Take Over Certificate since the previous 4 weekly project review meeting is a Late Train; and

(b) in respect of each Late Train, the total number of days of delay suffered.

The parties shall be under no obligation at that meeting to agree or consider the number of days of delay for the financial consequences of which the Company and/or the Contractor is responsible.

1.7.3.1 Responsibility for the financial consequences of delay shall be determined in accordance with the following formulae:

(a) $X = Z - A - B - C - D - E - F$; and

(b) $Y = A + B + C + D + E + F$;

where:

X is the number of days of delay for the financial consequences of which the Contractor is responsible;

Y is the number of days of delay for the financial consequences of which the Company is responsible;

Z is the number of days elapsed between (but excluding) the relative Train Milestone Date in respect of the Late Train and (and including) the date on

which a Take Over Certificate or Qualified Take Over Certificate was issued in respect of the Late Train;

A is the amount, if any, by which the total number of days actually taken by the Company in relation to the matters referred to in (a) to (d) below in respect of the Late Train is greater or less than N, being the total number of days available to the Company in relation to:

(a) the transfer of a Train to the Northern Line from Ruislip Depot (or other specified delivery location) following receipt of a notice from the Contractor pursuant to Clause 8.2.2, being the number of days permitted for the Company to effect such transfer under such Clause;

(b) the counter-signature of a fitness to run certificate following transfer of a Train to the Northern Line and the commissioning of such Train by the Contractor, being 1 day;

(c) the provision of train paths and Train Operators for the 1600km endurance running on the Northern Line, being 12 days;

(d) the issue of a Take Over or Qualified Take Over Certificate following receipt from the Contractor of the requisite Documentation, being 7 days;

and, the value of A shall be the difference between the number of days actually taken and N provided that:

(i) if the number of days actually taken is less than N, the value of A shall be negative;

(ii) if the number of days actually taken is greater than N, the value of A shall be positive; and

(iii) if the number of days actually taken is equal to N, the value of A shall be nil;

N is 20 plus the relevant number of days in (a) above permitted for the Company to transfer the relevant Late Train to the Northern Line;

B is the total number of days by which the Project Manager has extended the relative Train Milestone Date in relation to the Late Train pursuant to Clause 12.4 due to the occurrence of the Force Majeure Event specified in Clause 21.1.1(g);

C is the total number of days by which the Project Manager has extended the relative Train Milestone Date in relation to the Late Train pursuant to Clause 12.4 other than pursuant to Clause 12.4(e);

D is the total number of days by which the Project Manager has extended the relative Train Milestone Date in relation to the Late Train pursuant to a Variation Order;

E is the total number of days in relation to which the Contractor was not in receipt of but was properly entitled to:

(a) a Certificate of Substantial Completion; and/or

(b) a Take Over Certificate in respect of the Trackside Equipment including the Enhanced Existing VHF Train Radio in respect only of the section of the Company's Railway from Golders Green to Edgware (but excluding the Final UHF Trunked Radio and the Enhanced Existing VHF Train Radio in respect of the other sections of the Company's Railway);

and the non-issue of either such Certificate resulted in a delay to the Contractor obtaining a Take Over Certificate or Qualified Take Over Certificate in respect of the Late Train; and

F is the total number of days in relation to which there was a Clause 8.4.1 hold order (as defined in Clause 8.4.1) outstanding in respect of the Late Train or a Clause 9.3.2 hold order (as defined in Clause 9.3.2) outstanding or a Clause 9.A.3.2 hold order (as defined in Clause 9.A.3.2.) outstanding and (in the case of the issue of a Clause 9.3.2 hold order or a Clause 9.A.3.2 hold order) such hold order resulted in a delay to the Contractor obtaining a Take Over Certificate or Qualified Take Over Certificate in respect of the Late Train.

1.7.3.2 To the extent that any day of delay is taken into account in determining any of A to F (inclusive), such day shall not be taken into account in determining any of the others of A to F (inclusive).

1.7.4. Not later than 14 days after the meeting at which the parties agree that a Train is a Late Train and the total number of days of delay suffered in respect of such Train, the Contractor shall provide the Company with a schedule stating the number of days of delay it regards as being attributable to each of the Company and the Contractor in relation to the financial consequences of such delay, with full supporting reasons, in accordance with the format and components of the formulae set out in paragraph 1.7.3.1.

1.7.5. At the next 4 weekly meeting the parties shall endeavour to agree on the number of days of delay in respect of which each of them is responsible for the financial consequences in accordance with the foregoing principles and shall thereupon complete and sign the fault attribution schedule in respect of the Late Train. If the parties are not in dispute in relation to which of them is responsible for the financial consequences of any days of delay, they shall also certify the date (the

Contractor Fault Date) on which the Take Over Certificate or Qualified Take Over Certificate would have been issued in respect of any Train which is a Late Train if account were taken only of delays which are agreed to be attributable, in accordance with this paragraph 1.7, to the Contractor (which for the avoidance of doubt shall be the date agreed as the date X days (where X is determined in accordance with paragraph 1.7.3.1) after the relative Train Milestone Date (disregarding the effect of any extensions thereto in accordance with Clause 12 or the variation procedure set out in paragraph 8) in respect of such Train.

1.7.6. In the event that the parties fail to reach agreement on the allocation of responsibility for the financial consequences of any days of delay, they shall sign the fault attribution schedule in respect of those days of delay on which they do agree and shall certify therein the number of days in respect of which they do not agree. The parties shall endeavour to reach agreement on the days certified as being in dispute at the next two 4 weekly project review meetings.

1.7.7 Subject to paragraph 1.7.8, not later than 4 months after the issue of the last Take Over Certificate or Qualified Take Over Certificate in respect of a Train, the Company and the Contractor shall sign a schedule (the ***Contractor Fault Schedule***) in the form set out in Annex 4 to the notional lease incorporated as Part II of Section 1 of Part B of Schedule 10 setting out the Contractor Fault Date on which they are agreed pursuant to paragraphs 1.7.5 and 1.7.6 in respect of each Train and the Contractor shall promptly deliver the Contractor Fault Schedule so completed and signed to the Finance Parties pursuant to those paragraphs 4.2 of the financial schedules to each of the Trains Head Lease, the Equipment Head Lease and the Sub-Sub-Lease as the contractor fault schedule referred to in such paragraphs 4.2.

1.7.8 If, following the meetings referred to in paragraphs 1.7.5 and 1.7.6, the parties have failed to reach agreement in respect of any days of delay in respect of any Late

Train by the date which is 4 months after the issue of the last Take Over Certificate or Qualified Take Over Certificate in respect of a Train, the parties shall agree to appoint an independent third party to resolve any outstanding disputes (including any days certified as being in dispute in accordance with paragraph 1.7.6 that remain in dispute) for the purpose only of submitting a provisional contractor fault schedule to the Finance Parties pursuant to paragraph 4.7 of the financial schedules to each of the Trains Head Lease, the Equipment Head Lease and the Sub-Sub-Lease. In the event that the parties fail to reach agreement on the identity of the independent third party, he shall be appointed by the President of the Institute of Mechanical Engineers. The independent third party shall, having heard submissions from both parties and by the date which is 6 months less 14 days after the issue of such Certificate, for such purpose, determine which party is to be responsible for the financial consequences of any disputed days of delay and notify to both parties in writing his determination as to the Contractor Fault Date in respect of each relevant Train. Following such determination, the Company and the Contractor shall sign a Contractor Fault Schedule which shall record the Contractor Fault Date, in respect of each Train, on which they are agreed pursuant to paragraphs 1.7.5 and/or 1.7.6 or, to the extent that such date in relation to any Train has not then been agreed by the parties, as determined by the independent expert pursuant to this paragraph 1.7.8 and the Contractor shall promptly (and in any event not later than the date which is 6 months after the issue of such Certificate) deliver the Contractor Fault Schedule so completed and signed to the Finance Parties pursuant to paragraph 4.7 of the financial schedules to each of the Trains Head Lease, the Equipment Head Lease and the Sub-Sub-Lease as the contractor fault schedule referred to in such paragraphs 4.7.

1.7.9 Prior to the date which is 18 months after the issue of the last Take Over Certificate or Qualified Take Over Certificate in respect of a Train, the Company and the Contractor shall sign a Contractor Fault Schedule which shall record the

Contractor Fault Date, in respect of each Train, on which they are agreed pursuant to paragraphs 1.7.5 and/or 1.7.6 save that if and to the extent that such date in relation to any Train has not then been agreed by the parties or determined by application of the procedures provided for in Clause 47, the Contractor Fault Schedule to be signed by the Company and the Contractor under this paragraph 1.7.9 shall record the date which the Company maintains is the Contractor Fault Date in respect of such Train. The Contractor shall promptly (and in any event not later than the date which is 18 months after the issue of such Certificate) deliver the Contractor Fault Schedule so completed and signed to the Finance Parties pursuant to paragraph 4.9.1 of the financial schedules to each of the Trains Head Lease, the Equipment Head Lease and the Sub-Sub-Lease as the contractor fault schedule referred to in those paragraphs 4.9.1.

1.8 SCRUTINY OF PREVIOUSLY SUPPLIED MATERIAL

1.8 Wheresoever any of the Contractor Parties has previously under a contract for the Company, submitted design scrutiny and type testing information and it can be demonstrated by the Contractor to the satisfaction of the Project Manager that:-

(a) the component equipment or system is directly comparable with that to be supplied under this Contract; and

(b) the component, equipment or system is unaffected by meeting the requirements of this Contract;

then the Contractor will have satisfied the design scrutiny and type testing requirement of this Contract in respect of that item when all the information previously supplied and approved under the provisions of any other contract has been issued to the Project Manager

2. DESIGN

2.1 GENERAL

2.1.1 The Contractor shall, except as may otherwise be provided in this Contract, submit to the Project Manager such designs and drawings as are necessary to show the general arrangement, layout and detail of the Trains, Equipment and Enabling Works and that the Trains, Equipment and Enabling Works will comply with this Contract.

2.1.2 The Project Manager shall have the right to request any additional details and to require the Contractor to make any changes in the design which in the Project Manager's opinion are necessary to accord with the provisions and intent of the specifications in Schedule 6. Such requirements of the Project Manager shall not entitle the Contractor to additional cost or extension of time.

2.1.3 Any Documentation relating to matters which may affect the interface between the Trains or the Existing Trains and/or the Equipment and any of:

(a) the operation of the service;

(b) the Passengers;

(c) the existing assets of the Company;

(d) safety;

shall be subject to the approval of the Project Manager.

Any Documentation containing information which may affect the maintainability or reliability of the Trains, Existing Trains or the Trackside Equipment shall be provided to the Project Manager for his information and review.

In respect of the Enabling Works the conceptual design of each work package with the Enabling Works together with any drawing or method statement which impacts on the long term integrity of any existing Depot structure shall be subject to the approval of the Project Manager.

2.1.4 The Contractor shall give the Project Manager notice in writing of any further information from the Company that is required for the design and/or construction of the Trains, Equipment or Enabling Works or for the Services and to which the Contractor is entitled under this Contract. The Contractor shall allow a reasonable period of time (not more than 10 Working Days) for the Project Manager to supply such information, which period shall take account of the nature of the information requested.

2.1.5 If in the opinion of the Project Manager any design or drawing submitted by the Contractor does not comply with this Contract he shall so inform the Contractor in writing giving his reasons. The Contractor shall re-submit the design or drawing with appropriate modifications.

2.1.6 The Contractor shall notify the Project Manager if the Contractor wishes to modify any design or drawing which the Project Manager has previously approved and shall submit the modified design or drawing.

2.1.7 The Contractor when submitting designs or drawings shall supply to the Project Manager three paper copies of such other designs, drawings, specifications, documents and information as he may require.

2.1.8 Where any part of the Trains, Equipment or Enabling Works has been designed by or on behalf of the Company the Contractor shall check the interface design and the Contractor shall accept responsibility at the interface therefor having first obtained the approval of the Project Manager for any modifications thereto which

the Contractor considers to be necessary. The Company shall allow a minimum of 12 Working Days for any document generated by a third party to be approved by the Contractor.

2.1.9 Scrutiny in this Schedule shall mean either review or approval by the Project Manager.

2.2. DESIGN ASSURANCE PROGRAMME

In accordance with the dates set out in Schedule 5, the Contractor shall submit a detailed listing and programme identifying all design scrutiny submissions and design scrutiny meetings to the Project Manager for approval. The list and programme shall cover all systems, subsystems, components and processes.

The programme shall ensure a regular flow of submissions throughout all scrutiny stages, to avoid delays to this Contract arising from uneven workload. The programme shall be reviewed on a 4 weekly basis in line with the requirements of this Contract.

The Contractor shall allow 10 Working Days from receipt of design submittals by the Company for the scrutiny of such submittals.

The Contractor shall in preparing the design assurance programme schedule the scrutiny of associated subsystems to the same period and preferably to the same meeting. If this becomes impractical, the Project Manager shall be informed and agreement sought for rescheduling.

The Project Manager shall have the right to call for submissions or design scrutiny meetings additional to those identified on the programme.

2.3 DESIGN/PROCESS SCRUTINY AND ASSURANCE

2.3.1 Design/Process Scrutiny and Assurance Procedure

2.3.1.1 General

The Contractor shall supply for scrutiny by the Project Manager all information identified under paragraph 2.2 above required for the design, construction, manufacture, installation, testing, maintenance and operation of the Trains, the Equipment the Enabling Works and the provisions of the Services. The Contractor shall implement the principles described in Company Standard RSE/STD/022 Parts 1, 2 and 3 in the design process.

2.3.2 Design and Process Scrutiny Submissions

2.3.2.1 General

The Contractor shall provide all of the documentation specified in this Schedule.

2.3.2.2 Design and Process Scrutiny Stages

The design and process scrutiny procedure shall be carried out in three stages. The following three stages should normally be completed:

Conceptual Design/Process Definition (incorporating aesthetic design)

Preliminary Design/Process Definition

Final Design/Process Definition

In constructing the design assurance programme the Contractor shall incorporate each of the 3 stages identified above and the Contractor shall submit deliverable documentation against each of the 3 stages for scrutiny by the Project Manager. Progress of the submissions and their scrutiny shall be monitored through the design scrutiny meetings.

2.3.2.3 Design and Process Scrutiny Procedure

2.3.2.3.1 General

The design of all systems, subsystems and components identified in the design assurance programme relating to the Trains, Equipment and the processes used in the Enabling Works and the Services are to be scrutinised through the procedure outlined. The Project Manager may, at his discretion, allow certain designs or processes (previously used in similar applications by the Company) to pass directly to final design/process scrutiny.

2.3.2.3.2 Conceptual Design/Process Scrutiny

The Contractor shall provide to the Project Manager basic design solutions or processes that will be utilised for major elements of the Trains, Equipment, Enabling Works or Services identified in the design assurance programme. This phase shall include an aesthetic design scrutiny. In this respect the Contractor shall provide demonstrations of the aesthetic aspects of the design of the Trains and the Equipment (demonstrations here means colour renderings, CAD simulations and/or models).

In respect of the Enabling Works the following information shall be submitted:

(a) brief description of the asset, and its condition, to be modified, installed, replaced or repaired. As well as describing the new work, a complete list of all drawings which describe the existing asset shall be included to the design process;

(b) preliminary drawings of the proposal;

(c) summary of Ground Conditions detailing the ground's capacity, ground water information and contamination.

Where information pertinent to existing construction is missing, a brief description of the procedure to obtain the missing information should be included.

2.3.2.3.3 **Preliminary Design/Process Scrutiny**

The Contractor shall have achieved near to 50% completion of the final design of the Trains and the Equipment, or 50% completion of the definition of the processes to be used in the Enabling Works or Services. Full scale mock-ups (for the cab, the traction brake controller, the detrainment device, and the saloon interior) would be expected to be scrutinised at this stage.

2.3.2.3.4 **Final Design/Process Scrutiny**

The Contractor shall have achieved near to 95% completion of the final design of the Trains and the Equipment, or 95% completion of the definition of the processes to be used in the Services or Enabling Works.

2.3.2.3.5 **Format of Design/Process Scrutiny Submissions**

The requirements in respect of drawings are set out in Schedule 13.

The Project Manager reserves the right to reject outright any substandard submissions or submissions which are a mere repeat of previously rejected submissions. Additionally, the Project Manager shall be at liberty to request extra information from time to time should it be felt that insufficient information has been presented in a design submission or else that further detail is required.

2.3.2.3.6 **Response Time to Queries**

The Contractor shall respond to queries relating to design scrutiny submissions and a solution to non-compliance must be submitted and agreed within 14 Working Days of the non-compliance being raised by the Project Manager. If a written response is submitted, it shall be to the same standard as design scrutiny submissions. In the event of an error or omission in the documentation provided by the Company, then within 14 days of such error or omission being brought to his attention the Project

Manager shall, in writing, provide the Contractor with clarification of those parameters that are in error or have been omitted.

2.3.2.3.7 **Design or Process Approval Procedure**

One copy of each document which the Project Manager has decided is subject to approval will be returned by the Project Manager with the indications "Approved", "Approved Subject to Amendment", or "Not Approved". Unless further authorisations are required by Schedule 6, the indication "Approved Subject to Amendment" shall give the Contractor the authorisation to carry out work, provided that the required corrections, if any, are followed.

Where a document is subject to amendment, the subsequent scrutiny shall be limited to the scope of that amendment.

When any Documentation bears the note "Not Approved", the Contractor shall make the necessary revisions and shall resubmit to the Project Manager within the subsequent 14 Working Days the requisite number of copies for approval and the Contractor shall not be entitled to any additional cost or extension of time.

Where there is a need to consider the effect of the design of one subsystem on another, which may be received at a different time, approval may be granted "subject to" satisfactory review of another sub-system. This will be permitted only at the Project Manager's discretion.

The Contractor shall ensure that the final signatory of any design document submitted for scrutiny is a competent person.

2.3.3 **Design Assurance Requirements**

The principles to be followed in the design of the Trains, the Enabling Works and the Equipment are set out in Company Standard RSE/STD/030 Part 1.

2.3.4 Special Design Scrutiny Requirements for the Trackside Equipment

2.3.4.1 Systems Requirements Specification (SRS)

The system requirements specification (***SRS***) for the Trackside Equipment is a document which shall be produced by the Contractor following a comprehensive study of the operational requirements.

(a) The SRS shall translate the concept of operations into a detailed technical definition of the proposed system, covering both hardware and software, ensuring that each and every operational clause is appropriately expressed in terms of the technical requirements.

(b) The SRS shall include formal specifications of all boundary conditions and interfaces.

(c) The SRS shall identify and define the required performance parameters that will later form the basis for system validation testing.

(d) The items covered shall include:

(i) functions system modes (normal, special, degraded);

(ii) performance (picture quality, clarity, stability etc.);

(iii) constraints (EMC requirements, RFI,) EEC Directive labelling to 89/336/EEC etc.;

(iv) reliability/availability (installation, recovery, error handling, self test, diagnostics, MTBF/MTTR);

(v) expansion capability and maintainability (of both hardware and software); and

(vi) security test criteria.

2.4 SPECIAL REQUIREMENTS FOR EMC IN RESPECT OF THE TRAINS

2.4.1 General

2.4.1.1 The Contractor shall demonstrate by theoretical analysis that the design of the Electrical System meets the requirements of Schedule 6, Part A. Calculations shall be produced for each module within the Electrical System and the results summed to produce the system total. The Contractor shall state assumptions made in support of these calculations.

2.4.1.2 In carrying out calculations, due account shall be taken of both steady state and transient conditions including those of all closed loop controllers. The calculations must be made for all Normal Modes of Operation and all Failure Modes. The transient conditions generated by in-built protection equipment shall be taken into account.

2.4.1.3 In the circuit analysis, calculations shall be made for all component tolerance effects (due to manufacture, environment and ageing) and all possible component Failure Modes. If any component can exist in a dormant Failure Mode, the analysis must assume that the component has failed. The Contractor must identify all component Failure Modes considered and produce evidence for the Project Manager of its completeness.

2.4.1.4 If, in order to meet the requirements of Schedule 6 Part A, proof testing of components is necessary, the Contractor must identify all components to be tested, specify the interval between routine tests, define the test procedure and provide pass criteria which must be achieved.

2.4.1.5 The Contractor shall supply documentation showing how system safety and reliability is ensured. It shall include Failure Modes, system failures, the effect of

human intervention and how equipment thresholds have been set in order to keep them above worst case interference level; and how equipment tolerances and other characteristics in the specification have been allowed for in designing the system. All equipment interfaces for any Vital System shall be included whether the equipment is room, track or Train mounted. This information shall be presented in one coherent document specifically covering the proposed system.

2.4.1.6 Unless otherwise stated, the documents shall be supplied to include all the requirements as listed in Schedule 13, section 3. Documents listed in Schedule 6, Part A, shall be submitted.

2.4.1.7 The Project Manager shall conduct an independent safety audit for both the system and its component parts and shall therefore require access to all the relevant design and production information. The Contractor shall supply sufficient documentation and analysis in a form acceptable to the Project Manager.

2.4.1.8 If any system incorporates software which could affect the meeting of the safety requirements in Schedule 6, Part A, then the software must be developed to safety integrity level 4 of the Standards IEC 65-WG 9 and IEC 65-WG 10 in addition to the general requirements for software specified in Schedule 6, Part A, section 4, sub-section 4.12.

2.4.1.9 If any system which employs software to control equipment, which could affect the levels of interference generated, is directly or indirectly affected by the correctness of that software, the Contractor must provide an analysis to confirm that the generation of interference will not exceed the values given in Schedule 6, Part A, Section 10. It is essential that the software be written in such a way that meaningful analysis can be carried out. This analysis must be supported by documentation as listed in Schedule 6, Part A, section 10, sub-section 104.10 as a minimum requirement.

2.4.2 **Hardware Design Scrutiny (EMC specific)**

2.4.2.1 As a minimum, the Contractor shall submit the documents listed in paragraph 2.4.2.3 for the review of the EMC. An alternative set may be agreed with the Project Manager if it is to cover the same material. This agreement must be made within the conceptual design review period.

2.4.2.2 The design scrutiny documents should be separated into safety critical and non safety critical design scrutiny documents. The safety critical documents will be subject to safety audit.

2.4.2.3 The list of documents to be submitted shall include:

(a) radiated EMI requirements - documentation shall be provided to demonstrate by design how the emission of radiated EMI has been minimised. Documents are required to demonstrate what steps have been taken to achieve the required immunity of equipment to radiated EMI from all other sources;

(b) magnetic field requirements - documentation of all calculations is required to show that the magnetic field requirements have been met for all conditions;

(c) inductive interference requirement - the Project Manager shall be provided with documentation on the calculations used to show that the psophometrically weighted current taken by the Train does not exceed that shown in the Schedule 6, Part A;

(d) conducted interference requirements - documentation of all calculations is required to show the conducted interference requirements have been met for all conditions;

(e) capacitive interference requirements - documentation of all calculations is required to show the capacitive interference requirements have been met for all conditions;

(f) signal compatibility study - documentation of steps taken to avoid interference with the existing signalling system, which should include details of any correspondence with the signalling contractor to ensure EMC. The areas to be covered shall include:

(i) list of specific EMC requirements for each signalling equipment type;

(ii) description of the traction and auxiliary equipment including circuit diagrams;

(iii) fault tree analysis;

(iv) FMECA;

(v) normal and fault supply ripple current calculations for traction and auxiliary converter;

(vi) measures to minimise close up effects;

(vii) supply filter resonant frequency design;

(viii) RFI shielding methods;

(ix) analysis of the control system regarding potential EMI mechanisms;

(x) reliability models;

(xi) modulation and beating analysis; and

(xii) design of hardware watchdogs and monitors;

(g) communications compatibility study - documentation of steps taken to avoid radiated EMI from the Trains affecting communications equipment. Calculations shall be carried out and documented to show the levels of induced voltage on cables will not exceed the CCITT recommendation; and

(h) other design scrutiny documents - any other Train mounted system which has the potential for generating and being susceptible to electrical interference shall be included. The schematics shall contain information on the arrangement and distribution of equipment within the Train. This includes:

(i) component values, ratings and tolerances;

(ii) a functional description of each module;

(iii) current wave forms in the conductors to an equipment module supplying or drawing current and voltage wave forms across the terminals of the module;

(iv) measurements of the spectral distribution and amplitudes of the current drawn or generated by any equipment module employing power electronic switching techniques;

(v) documentation to provide evidence of the quality management process which will be applied to ensure that manufactured equipment is held within design limits; and

(vi) methods of screening for susceptibility or for reducing emissions.

For the purpose of Electromagnetic Compatibility considerations, in order to provide protection against excessive Emissions for sensitive equipment susceptible to Electromagnetic Interference and for the purpose of safety analysis, the Failure Modes considered will be those contained in ORE Directive "Use of Electronic

Components in Railway Signalling Question A 155.3 Draft 5" supplemented by any possible additional requirements of the Project Manager.

3. RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY REQUIREMENTS

The Contractor shall devise and present a programme of work, which demonstrates how the Contractor will achieve the reliability, availability, maintainability and safety ("RAMS") requirements more specifically defined in Schedule 6, Part A. The programme of work shall ensure that Train Milestone Dates, Train Target Delivery Dates or Target Completion Dates are not prejudiced and shall ensure that sufficient time is available for the Project, Train Target Delivery Dates Manager to approve or review the output of the programme. The programme shall detail all foreseen deliverables, with their respective timing, to the satisfaction of the Project Manager, and shall form an integral part of the design and management processes.

The Contractor shall ensure that the RAMS documentation, regardless of authorship, is prepared using consistent methodology and style with all data sources identified and calculations readily traceable between related document sections. Such documentation shall be suitable, to the satisfaction of the Project Manager, for retention as a permanent record in support of the Company's obligations under The Railways and Other Transport Systems (Approval of Work, Plant and Equipment) Regulations 1994 and The Railways (Safety Case) Regulations 1994. The Project Manager may specify issue in electronic format compatible with the Company's systems for the time being in use, in addition to hard copy. To this end the Contractor shall consistently use a data management system, to the satisfaction of the Project Manager, for the retention and management of all data. Copies of any RAMS documentation shall be provided to the Project Manager on request.

3.1 RELIABILITY MANAGEMENT

The Contractor shall devise, implement, and control a reliability management and reporting programme to the satisfaction of the Project Manager. The programme shall cover all stages from commencement of design through manufacture, test and commissioning, introduction into service, and ongoing operation throughout the Contract Duration, with no discontinuity of reporting or underlying methodology. It shall conform to the general requirements of BS 5760 and subsequently, it shall address all elements of the specification and shall incorporate all requirements more specifically described below and in Schedule 6.

The Contractor shall set reliability performance criteria for the Trains and the Equipment and for each area of the constituent element of each sub-system and for the interaction of sub-systems in discrete systems, compliant with the overall reliability performance criteria set out in Schedule 6. The Contractor shall submit a schedule showing his initial apportionments for the approval of the Project Manager within eight weeks of the date of this Contract. This schedule shall be updated and re-issued as part of the reporting process described in paragraph 3.2. The Contractor shall demonstrate by regular reporting that the overall design review process uses the reliability forecasts in a pro-active manner to aid design development and shall identify appropriate procurement quality factors for inclusion in specifications.

Paragraphs 3.1.1.3 and 3.1.14 below are included to provide a basis for the calculation of the reliability criteria in a consistent manner.

3.1.1 Design

3.1.1.1 Existing Reliability Information

The Company will make available to the Contractor copies of all such existing reliability information and other records pertaining to the Company's railway network as the Contractor may reasonably require for information. For the avoidance of

doubt, Clause 14.4.4(c) shall apply in respect of any such information supplied to the Contractor.

3.1.1.2 **Methods**

During the design the Contractor shall apply recognised methods of reliability analysis in a consistent manner to all elements of the specification to the satisfaction of the Project Manager. These methods include but are not limited to:

(a) parts count reliability prediction;

(b) parts stress analysis;

(c) FMECA; and

(d) fault and event tree analyses.

The methods, software, data sources and all assumptions made shall be agreed by the Project Manager prior to use. The Project Manager reserves a right to require use, in calculations, of data based on the Company's operating experience wherever in his judgement he considers it appropriate to do so.

The analyses shall consider all complete systems, in addition to discrete equipment or subsystems as furnished by the respective sub-contractors, with all safety-related failure modes highlighted. Wherever safety related Failure Modes are not self-revealing on occurrence, the Contractor shall demonstrate adequacy of design, maintenance, operational and other methods of control paying particular attention to the definition of actions or programmes required to be implemented by the Company or third parties.

3.1.1.3 **Operating Conditions**

Whenever equipment is contained within any form of enclosure, cubicle, or room, the Project Manager recommends that the reliability analyses include an estimate of maximum steady-state temperature anticipated within such enclosure in normal operation taking note of all heat sources enclosed or adjacent whether furnished by the Contractor or not.

3.1.1.4 **Trackside Equipment**

3.1.1.4.1 The Contractor shall set and work towards reliability targets for all Trackside Equipment such that the fleet reliability targets defined in Schedule 6, Part A, Section 3 are met.

3.1.1.4.2 For the purposes of this paragraph 3.1.1.4, the term "failure" shall mean any fault or combination of faults in trackside installations, including without limitation cabling, radiating antennae, and power supplies, which results in a Train or Existing Train Failure.

3.1.1.4.3 The Contractor may propose incorporating redundancy, high-reliability components, or other techniques wherever analysis indicate that these will permit achieving the overall targets in a cost-effective manner.

3.1.1.4.4. The preferred source for failure rate data used in forecasting for the trackside communications infrastructure is MIL-HDBK-217F. Notice 1: "Reliability Prediction of Electronic Equipment". The Contractor may propose alternatives for consideration by the Project Manager. The Company recognises that component tolerance "drift" or other conditions may constitute "failure" within the strict definitions of most data sources covering electronic components, but will not necessarily lead to any of the events listed in paragraph 3.1.1.4.2 when incorporated into the complete installations. The Contractor shall ensure visibility, with appropriate justification, of any factors used in its forecasting to compensate for this.

3.1.2 Manufacture and Test (the Trains and Trackside Equipment)

The RAMS process shall include review of all results from type tests, accelerated life test, service trials and similar information for Trains and Trackside Equipment. Where appropriate, these shall be substituted into reliability forecasts, in place of earlier data, to obtain earliest possible confirmation of design or indication of adverse trends.

3.1.3 Service Life (for Trains and Trackside Equipment)

3.1.3.1 Reliability Growth Analysis

The Contractor's reporting system shall incorporate analyses, both on equipment and system-wide bases for the Trains and Trackside Equipment, to verify whether the achieved reliability is constant or improving. The results shall be incorporated into the 4 weekly reporting, described in paragraph 3.2, in such a way that the forecasts of ultimate performance are updated to give earliest indication of adverse trends. The Contractor may use Duane, Cumulative Sum, or other recognised methods singly or in combination to the satisfaction of the Project Manager.

3.1.3.2 Failure Reporting and Data Collection

The Contractor shall devise, implement and manage a system of failure reporting and correlation to support the activities described in paragraphs 3.1.3.1 and 3.7. It shall be developed in co-operation with the Company to ensure compatibility with the Company's existing systems to the satisfaction of the Project Manager. The Contractor may recommend, and propose for consideration, alternatives to existing Company practices; however, the Company does not undertake that it will implement any proposals so made.

3.1.4 Design Scrutiny

All deliverables under this section shall be submitted as part of the design/process scrutiny more fully described in paragraph 2.3 of this Schedule.

3.1.5 **Safety And Reliability Plan**

The Contractor shall prepare and submit a safety and reliability plan for approval by the Project Manager in accordance with Schedule 5.

3.1.5.1 **Scope of Safety and Reliability Plan**

3.1.5.1.1 The safety and reliability plan shall address, without being limited to, the following:

(a) corporate health and safety policy statement;

(b) details of safety and reliability organisation covering:

(i) Contractor's internal organisation;

(ii) all sub-contractors (where applicable); and

(iii) CVs of key personnel;

(c) method by which any conflicts of interest between safety and other objectives will be resolved;

(d) corporate health and safety procedures covering:

(i) COSHH statements;

(ii) specific hazards descriptions;

(iii) Standards applicable;

(iv) systems of working and method statements; and

(v) training policies and requirements;

(e) accident records, including those of sub-contractors where applicable;

(f) list of statutory requirements, codes of practice, and similar standards considered to be applicable to the design;

(g) details of apportionment of overall contractual targets between the Contractor's work and that of any sub-contractors, including methods foreseen to control and demonstrate sub-contractor performances;

(h) details of methods to be applied during design, including foreseen data sources and criteria for pro-active use of forecasts during design;

(i) details of safety and reliability design scrutiny procedure;

(j) details of how the Company's safety working practices and procedures as set out in Schedule 8, and in particular the requirements of the Company's Rule Book and Appendices, will be incorporated into the Contractor's procedures and subsequently controlled;

(k) methods for identifying and controlling potential hazards at interfaces between the Contractor's work and that of sub-contractors and third parties;

(l) RAMS support methods by which design forecasts will be confirmed during initial operations as more fully defined in paragraph 3.8.4 of this Schedule; and

(m) provision of safety documentation to support the Company in preparing its overall safety case as per The Railways (Safety Case) Regulations 1994 and any submissions to the HMRI under the Railway and other Transport Systems (Approval of Works Plant and Equipment) Regulations 1994.

3.1.5.2 **Safety and Reliability Deliverables**

The safety and reliability deliverables shall include, in addition to the requirements of paragraphs 3.4. and 3.5 and without being limited to, the following (for the avoidance

of doubt, in relation to the Trains, the Equipment, the Enabling Works, the Services and the Existing Train Services):

(a) corporate health and safety policy;

(b) design safety plans;

(c) design 'RAMS' plans;

(d) Site safety plans;

(e) a list of statutory requirements and codes-of-practice;

(f) method statements;

(g) COSHH statements;

(h) system risk analyses (Hazans);

(i) Materials Inventory (showing 'Fire Code' compliance and waivers granted);

(j) design 'RAMS' reports:

(i) FMEA/FMECA;

(ii) ETA;

(iii) MTBF/MTBWSF;

(iv) availability reports;

(v) sensitivity analyses; and

(vi) manufacturing process FMECA;

(k) reliability growth management (RGM) plans;

(l) RGM system descriptions and procedures;

(m) novel features assessments;

(n) software validation plan;

(o) software validation procedures;

(p) manual handling assessments.

3.2. REPORTING AND FORECASTS

The programme to demonstrate the achievement of RAMS shall provide for reporting, at 4 week intervals, of progress, changes and trends. This reporting shall include forecasts of expected performance against the targets set out in Schedule 6 covering the complete scope of supply, and based on the latest available information at the report date. The forecasts shall be apportioned to the principal sub-systems of the Train or the Trackside Equipment in a logical manner, relating to their physical functions, to the satisfaction of the Project Manager. The reporting shall commence not more than 16 weeks after the date of this Contract and may be presented as part of overall project progress reporting.

3.3 SAFETY ASSESSMENT

The Company considers safety to be of paramount importance in the Company's Railway. The Contractor shall therefore produce a structured safety assessment, covering at least the requirements of paragraphs 3.4 and 3.5, but supplemented as necessary by other recognised techniques such as FMECA and ETA, to the satisfaction of the Project Manager. The assessment shall cover the entire Contract scope of supply.

3.4 HAZARDS AND OPERABILITY STUDIES (HAZOPS)

The Contractor shall perform a HAZOP, to be attended by representatives of the Company, to ensure that all safety aspects have been considered in a structured manner. Items identified by this study shall be followed to completion in a formally traceable manner, for example, by incorporation into a detailed risk assessment and subsequent regular scrutiny. The HAZOP reports shall include all items discussed whether noted for further action or not.

3.5 FAULT TREE ANALYSIS (FTA)

3.5.1 The Contractor shall identify and quantify all events where multiple faults combine, with or without human or other external factors, to produce conditions which:

(a) increase risk of death or injury;

(b) increase risk of collision, derailment or collapse;

(c) render a Train incapable of movement under its own power;

(d) result in evacuation of a Train; and

(e) cause any of the events listed in Schedule 6, Part A.

3.5.2 The Contractor shall prepare a list for approval and then perform the needed analyses. The Contractor shall particularly identify where dormant failures contribute to such events and shall demonstrate adequacy of maintenance regimes or other means of control. The Contractor may use fault or event tree analysis, tabular presentations, or other methods as appropriate, to the approval of the Project Manager. Where data used are common to, or result from, other analyses, then they shall be consistent and traceable between the respective documents. The results shall be presented as anticipated occurrence frequency, e.g. number of events expected in

fleet life. Assumptions as to 'demand' type event frequencies shall be made and documented as described in Schedule 6, Part A. Presentation as event probabilities is not acceptable.

3.6 EXTERNAL FACTORS ANALYSES

3.6.1 The Contractor shall demonstrate to the satisfaction of the Project Manager that due consideration has been given to external factors during design development. Such factors shall include but not be limited to:

(a) improper or unauthorised actions by Operators, Company's and Contractor's staff or Passengers;

(b) Operator error;

(c) vandalism or acts of terrorism;

(d) Permanent Way or other infrastructure defects, singly or in combination however caused;

(e) maintenance error;

(f) Train preparation error; and

(g) special needs of children or disabled persons.

3.6.2 The Project Manager will provide the Contractor with relevant information, where reasonably available, based on the Company's operating experience upon request.

3.7 MAINTAINABILITY

3.7.1 The Contractor shall use maintainability analysis techniques as a design phase aid to ensure and demonstrate that the targets set in Schedule 6, Part A and Schedule 6, Part B, are achievable. The analyses shall be performed as part of design

phase activities and shall cover anticipated unscheduled maintenance and repair activities implied by the reliability forecasts, as well as planned routine activities.

3.7.2 The Contractor shall ensure that all maintenance tasks are capable of being performed safely with negligible risk of the evolution of unsafe working practices, and that the possibility of errors has been "designed out" as far as is reasonably practicable. This may include "strip down and re-assemble" demonstrations.

3.8 RAMS SUPPORT

3.8.1 The reliability management activity, defined in paragraph 3.2, initiated in the delivery and installation phase shall be maintained throughout the Contract Duration.

3.8.2 From commencement of the service phase, the Contractor shall maintain a cumulative log of all failures occurring within Vital Systems, and High Integrity Systems, Vital Functions and Vital Systems, including dormant or redundant system failures. This shall be included in the periodic reporting described in paragraph 3.2. If at any time the failure rate so reported is in excess, in aggregate, of the limits set in paragraph 3.2 of Schedule 6, Part A, then the Contractor shall in addition report the confidence level with which the result could be considered compliant. The calculation method shall be subject to the approval of the Project Manager. A confidence level less than 90% will be deemed evidence of design defect and the Contractor shall propose a programme of corrective action, at no cost to the Company, except that the Project Manager at his sole discretion may allow further time, for accumulation of additional data, before confirming this.

3.8.3 The failure recording and reporting system shall provide means by which data is analysed to identify underlying causes and are progressively correlated with design data to give the earliest indication of adverse trends in a fully pro-active manner. It shall permit easy evaluation of alternative options for reliability

improvement as these are identified, should this be proved necessary. The Contractor shall demonstrate to the satisfaction of the Project Manager that the analytical techniques permit correlation and confirmation of failure causes, including but not limited to the following categories:

(a) random defectiveness;

(b) "infant mortality";

(c) defective batches;

(d) "rogue" vehicles;

(e) unanticipated human factors;

(f) unconsidered environmental factors;

(g) location or other external factors;

(h) unconsidered interface factors;

(i) design inadequacy; and

(j) "wear out".

3.8.4 As part of the safety and reliability plan referred to in paragraph 3.1.5.1, a full description, covering all reporting functions, analytical techniques to be used and interfaces with other management systems, shall be provided.

4. REQUIREMENTS FOR INSPECTION AND TESTING

4.1.1 General

(a) The Contractor shall compile (so as to comply, inter alia, with the requirements of paragraph 4.1.1.1) and carry out successfully a programme of tests (the ***test and inspection programme***) to satisfy himself and the Project

Manager that the Trains, the Trackside Equipment, the Enabling Works, and equipment for the Services are fit for purpose and comply with this Contract. The test programme shall include all the tests specified in this paragraph 4 and all other tests which the Contractor considers necessary to prove both the design and manufacture of the Trains, the Trackside Equipment, the equipment for the Services, and to prove design, manufacture, installation, commissioning and operational use of the Enabling Works.

(b) Testing will also be required for any modification to the design of the Trains, the Equipment, the Enabling Works, and equipment for the Services or following repair work carried out on any Trains, the Trackside Equipment, the Enabling Works, and equipment for the Services.

(c) The Project Manager may require the Contractor to carry out such additional tests not specified in the test and inspection programme as the Project Manager may deem necessary to prove the compliance of the Trains, the Trackside Equipment, the Enabling Works and the equipment for the Services with the requirements of this Contract.

4.1.1.1 **Test and Inspection Programme Requirements**

(a) The test and inspection programme shall be submitted by the Contractor to the Project Manager for approval to an agreed format and level of detail.

(b) The test and inspection programme shall detail the timescales required to undertake the tests in relation to the overall project programme, the location of the test and the specific test category to which each individual test relates. The tests and inspection programme shall similarly detail the timescales appropriate to inspection work as required in this section 4.

(c) By agreement with the Project Manager, the test and inspection programme may include tests that require to be undertaken on the Company's premises and using the Company's personnel, equipment and power supply.

4.1.1.2 **Test Equipment**

All performance measurements shall be made with calibrated instrumentation, unless the calibration process is included in the test procedure. General calibration procedures and maintenance of calibration records shall be described in the quality plan. Calibration certification shall be recorded in all test reports.

4.1.1.3 **Test Access and Witnessing**

(a) The Contractor is required to permit the Project Manager to inspect the Trains, the Equipment, the Enabling Works, or equipment for the Services and witness testing, at any time of the Trains, the Equipment, the Enabling Works, or equipment for the Services to the Company.

(b) The Project Manager shall have the right to attend any test, wherever held. The Contractor shall provide, at his own cost, such facilities as may reasonably be required by the Project Manager for the purposes of witnessing tests or inspecting the Trains, the Equipment, the Enabling Works, or equipment for the Services .

(c) The Project Manager shall be invited, and shall be given at least 10 Working Days advance notice, to witness all the tests to be performed, although he will not necessarily attend all tests. The Project Manager will confirm his intention to attend any specific test at least 2 Working Days before the test commences.

4.1.1.4 **Type Test Failures**

(a) Should the results of any test indicate that the requirements of this Contract or any other provisions of this Contract have not been met, the Contractor shall

take such remedial action as is necessary and shall repeat any such test, until a successful outcome is achieved.

(b) The Project Manager shall be informed of any test failure within 5 Working Days of the date of the unsuccessful test.

(c) The Contractor shall be responsible for all costs associated with all testing including failed testing, remedial actions arising therefrom and consequent repeat testing.

4.1.1.5 **Postponement of Tests**

If any tests for Trains, Trackside Equipment, Enabling Works, or equipment for the Services are delayed or postponed without reasonable prior notice, the Contractor shall pay any costs incurred by the Company in connection with such postponement, unless the delay or postponement is due to factors which the Company considers outside the control of the Contractor.

4.1.2 **Waiver of Type Testing**

(a) The Contractor may apply to the Project Manager for a waiver of type testing for certain Equipment if either the following criteria are satisfied:

(i) the Equipment has previously been delivered and satisfactorily operated in a similar application by the Company; or

(ii) the Equipment has previously been tested by a reputable testing agency in a way similar to that specified in this specification with relevant test certification and reports which are acceptable to the Project Manager.

(b) A waiver of type testing, either in part or in full, is entirely at the discretion of the Project Manager.

(c) A provisional waiver of testing may be requested for Equipment or Trains which are to be delivered and operated in a similar application. Full waiver will be dependant upon the satisfactory testing of that application .

(d) The Project Manager will normally provide a waiver for the 25%, 50% and 75% type testing for Trains if service performance is satisfactory.

(e) For Trackside Equipment type testing will be performed on the first production equipment only.

4.1.3 **Development Trials**

Where the Contractor wishes to carry out development trials of new or unproved Equipment on Trains, or other Company assets on the Company's railway network or as part of the Enabling Works a full justification for any such test shall be submitted to the Company which shall include, but may not be limited to, the following:

(a) scope and objectives of the test;

(b) proposed test method to be used (instrumented test train or Train, Passenger service trial, etc.);

(c) proposed length of trial period;

(d) details of the equipment to be fitted for all phases of the trial;

(e) outline installation details;

(f) provisional safety, test and documentation plans for the trial; and

(g) decommissioning arrangements.

Following agreement with the Company for the trial to commence the Contractor shall develop and agree with the Company detailed arrangements for the trial which

shall finalise the requirements, these shall include the responsibility for costs associated with such trials.

The Contractor acknowledges that before any such trial can actually commence formal HMRI and Company approval is required. The Contractor shall provide to the Company a detailed description of the trial in accordance with the Railways and Other Transport Systems (Approval of Works, Plant and Equipment) Regulation 1994.

A technical analysis of the trial modification shall be provided by the Contractor for internal use by the Company.

4.2 PARTICULAR TEST REQUIREMENTS FOR TRAINS

4.2.1 Testing Documentation

4.2.1.1 Test Plan

The test plan for the Trains, in conjunction with the quality plan and testing and inspection programme, shall contain sufficient detail to demonstrate that tests proposed ensure that the final deliverables fully meet the requirements of this Contract.

4.2.1.2. Test Schedules

(a) The Contractor shall compile test schedules for Trains for all the tests detailed in the test programme and all test schedules shall document:

(i) the purpose and nature of the tests and inspections;

(ii) the procedure to be used;

(iii) the instrumentation required;

(iv) the expected results and tolerances allowed; and

(v) objective pass and fail criteria.

(b) All tests shall be carried out only in accordance with test schedules produced by the Contractor and approved by the Project Manager. The test schedules shall ensure that testing is carried out in accordance with the appropriate standards and in a safe manner.

(c) Should the Project Manager believe that any test or part of a test performed did not meet the test schedule requirements, the test or part of the test shall be repeated, at no charge to the Company, until it is performed to the Project Manager's satisfaction.

(d) Individual test and inspection schedules shall be submitted to the Project Manager no less than 25 Working Days before the test is due to take place to allow the Project Manager to satisfy himself that the tests or inspections are adequate in all respects. The Project Manager shall return reviewed test schedules no less than 10 Working Days before any test or inspection. An agreed test schedule shall be made available to the Project Manager 5 Working Days before any test or inspection.

4.2.1.3 **Type Test Reports**

The Contractor shall provide test reports for type tests undertaken on Trains to the Project Manager. Test reports submitted shall contain the following information as a minimum:

(a) objectives;

(b) method;

(c) expected results;

(d) pass/fail criteria;

(e) test results - comparison with expected results and pass/fail criteria;

(f) the test circuit schematic, associated drawings and documentation;

(g) test and inspection result sheets;

(h) test and inspection certificate sheets;

(i) the test equipment calibration details;

(j) the system to be tested incorporating any unique serial number or identification system of such items;

(k) conclusion; and

(l) recommendations.

4.2.1.4 **Type Test Results**

Two copies of the results of all tests carried out by the Contractor in respect of the Trains, whether witnessed by the Project Manager or not, shall be submitted to the Project Manager within 10 Working Days of completion of each test.

4.2.2 Categories of Tests

4.2.2.1 **Type Tests**

(a) The function of a type test for Trains is to demonstrate that the test specimen meets its specified performance under all specified operating and environmental conditions.

(b) No type testing shall be carried out without the type test schedule being approved.

(c) Type tests of components or items of equipment shall be carried out on the first-off production article. Thereafter, a type test or a sub-set thereof (by agreement with the Project Manager) shall be carried out at 25%, 50% and 75% of the way through production, to ensure that no deterioration of quality

has occurred. The Contractor may apply for an exemption for items supplied against an agreed standard and quality assurance programme.

4.2.2.2 **Routine Tests**

Routine tests for Trains shall demonstrate that defined parameters for particular equipment have been correctly reproduced.

4.2.2.2.1 All items of equipment shall undergo routine tests or inspections as appropriate to their function on every production item.

4.2.2.2.2 For systems and subsystems, routine testing shall take place at various stages throughout the build process to ensure that each stage has been correctly completed before production proceeds.

4.2.2.3 **Acceptance of Delivery Test**

The Contractor shall carry out Acceptance of Delivery Tests for the Trains as required by paragraph 4.3.3.3 and these tests shall consist of a sub-set of the First Train type test.

4.3 TESTS FOR TRAINS

(a) The Contractor shall conduct all practicable tests to ensure that all cars, both individually and when formed into Units, then coupled into Trains, are correctly functioning mechanically, electrically and pneumatically in accordance with this Contract. Testing shall include, but not be limited to, the items listed below.

(b) The Project Manager reserves the right to require that certain elements of the type test are carried out on cars or Units (as the case may be) other than the first off production, in order to expedite the test programme.

(c) A final routine test on every car, Unit and Train shall be carried out completely and successfully before any car, Unit or Train is despatched from the Contractor's works.

4.3.1 **Single Car Tests**

4.3.1.1 Type tests on first off cars of each type:

(a) bogie clearance and swing;

(b) verification of cable and hose lengths; and

(c) gauge compliance.

4.3.1.2 Routine tests on all cars:

(a) proof against water ingress (this test must be carried out before any interior panelling is fitted);

(b) air system pressure stand-up;

(c) earth bond continuity;

(d) underfloor equipment fixing security; and

(e) electrical continuity and insulation test.

4.3.2 **Unit Tests**

The semi-permanently coupled Unit is the lowest level on which valid tests of functionality can be performed. The Contractor shall carry out a full range of electrical, mechanical and pneumatic tests on every Unit.

4.3.2.1 Type tests on first off Unit of each type:

(a) car to car curving performance, including a full check of intercar service clearance and strain;

(b) the full performance levels of all systems and subsystems against the requirements of the specification; and

(c) wheel unloading.

4.3.2.2 Routine tests on all Units:

(a) Train wire continuity;

(b) control system functionality; and

(c) gauge compliance.

4.3.3 **Train Tests**

Complete Trains shall be tested both before transfer to the Company's premises and also before the Acceptance of Delivery Tests.

4.3.3.1 The Contractor shall test on all Trains before transfer (routine tests):

(a) control system functionality; and

(b) inter-unit coupling performance.

4.3.3.2 The Contractor shall carry out a comprehensive type Acceptance of Delivery Test on the First Train to demonstrate compliance with this Contract. This testing shall be conducted by the Contractor and witnessed by the Project Manager and shall include tests of the following:

(a) emergency and service brake performance under all load conditions;

(b) traction performance under all load conditions;

(c) Train motion resistance;

(d) Electromagnetic Interference;

(e) door system performance;

(f) saloon and cab environment;

(g) communication (audio and visual);

(h) control, monitoring and diagnostic systems;

(i) noise;

(j) ride, including air suspension (if fitted);

(k) dynamic gauge compliance;

(l) emergency system performance;

(m) endurance over 1600 km running;

(n) ATC interface provision; and

(o) bogie dynamic strain gauging.

4.3.3.3 The Contractor shall carry out Acceptance of Delivery Tests, to be witnessed by the Project Manager, at the Project Manager's discretion, on every Train so as to ensure that every Train is fully commissioned and fit for Passenger service. The Acceptance of Delivery Tests must be completed successfully before the Train is handed over to the Company. The tests shall, as a minimum, consist of the following:

(a) safety tests;

(b) static brake test;

(c) static and dynamic traction tests;

(d) communication tests (including radio and track to Train links);

(e) endurance (1600 km) test (this cannot be started until a limited running notice (not Passenger services) has been issued);

(f) control and monitoring tests; and

(g) any testing of items which require post-transfer fitment.

4.3.3.4 On completion of the tests referred in paragraph 4.3.3.3 (a), (b), (c), (d), (f) and (g) in respect of any Train, the Contractor shall give written notice thereof to the Company confirming that the Train is fit to run on the Company's Railway and such notice shall request that the Company permits the 1600km endurance test to proceed. After receipt of such notice, and provided the Project Manager is satisfied that such Train is in accordance with the notice the Project Manager shall issue a limited running notice (not Passenger services).

4.3.4 **Specific System Tests for Trains**

For the avoidance of doubt, the test programme for Trains shall include as a minimum:

4.3.4.1 **Traction and Braking Package**

The first complete traction and braking package shall be subject to a combined system test and be tested using simulated service conditions. The tests shall include all control systems and other key components.

4.3.4.2 **Kinematic Profile**

The Contractor shall prepare a detailed test schedule for demonstrating compliance with the kinematic profile requirements (referred to in Schedule 6, Part A) for agreement by the Project Manager.

4.3.4.3 **Side Sliding Door System**

The Contractor shall provide:

(a) a complete door system proving rig including sliding door leaves, operators, interlocks, seals and shrouds and valances. The rig shall be a rigid structure, a representative of the carbody structure; and

(b) an external, leaf-mounted door control push-button and signal transmission proving rig to demonstrate the performance of these items. This rig may be incorporated in the main door leaf rig described in paragraph 4.3.4.3(a).

Both rigs shall be supplied to the Company and shall operate in the open environment for one million cycles with no parameter deviating from the specified or agreed range or values. The rigs shall also be vibration tested by the Contractor.

The rigs shall be operated by the Company's personnel although free access at reasonable time will be given to the Contractor.

4.3.4.4 **Shoegear**

(a) The operation, performance and physical integrity of the proposed shoegear shall be confirmed by testing, both in the laboratory and on the Company's Railway, followed by service trials as approved by the Project Manager.

(b) The Company shall make available appropriate trains to mount one car set of shoegear as provided and fitted by the Contractor at the Contractor's expense.

(c) The testing shall be used to confirm compliance with specified requirements and to subject the shoegear to realistic service duty.

(d) All details of testing are subject to approval by the Project Manager.

4.3.4.5 **Electromagnetic Compatibility (EMC)**

4.3.4.5.1 **EMC Pre-Delivery Testing**

(a) EMC type testing shall be carried out on all items of equipment as identified in the design stage requiring attention regarding EMC.

(b) The Contractor may request at his choice, attendance by the Project Manager at the manufacturing factory prior to delivery to allow the Project Manager to provide the benefit of his experience to the Contractor and for the Contractor to illustrate how the specification will be met. However, this will not give design acceptance which can only be given by post-delivery acceptance test on Company's railway network.

4.3.4.5.2 **EMC Post Delivery Testing**

(a) Static and running tests will be carried out by the Contractor on an appropriate section of Company's railway network track to assist in verification that the specification has been met.

(b) The Contractor shall devise a programme of tests to exercise Trains in all modes of operation, including Failure Modes of the Electrical System. The Contractor shall make this document available to the Project Manager for review and approval throughout all stages of design.

(c) Details of these tests, including associated pass marks derived from the specification, shall be agreed with the Project Manager before test work commences.

(d) The Project Manager may request that tests be carried out to simulate the Failure Mode of any critical hardware/software component that is deemed to have a significant effect.

(e) Tests to demonstrate EMC shall include:

(i) signalling compatibility tests derived from Company standard S&CSE ST0062-A2 specification as well as additional tests identified in the relevant line specific appendices during design review stage;

(ii) communications compatibility tests derived from the communications compatibility specification and additional test identified during design review stage;

(iii) tests to satisfy the radiated EMI requirements described in Schedule 6, Part A;

(iv) tests to demonstrate the magnetic field requirements described in Schedule 6, Part A are met; and

(v) tests to demonstrate the inductive interference levels as stated in Schedule 6, Part A, section 10, are met.

4.3.4.6 **Air Suspension Unloading**

The Contractor shall carry out tests to prove that the rapid unloading of the air suspension system during detraining of Passengers does not cause the air suspension protection system to operate on any car type.

4.3.4.7 **Safety Proving Type Tests**

The Contractor shall prepare a detailed series of safety proving tests that shall be carried out as an Acceptance of Delivery Test and shall demonstrate the following:

(a) that the forecasts made to verify safety in the design of the Train (as referred to in Schedule 6, Part A, section 3 and Schedule 4, section 3) are satisfactorily achieved;

(b) that no single failure of any system or function shall cause the Train to become immobilised (e.g. tripping of a single MCB, etc.);

(c) that all dual redundant and "standby" redundant systems and functions perform and operate as required; and

(d) the achievement of the inherent detectability required within all High Integrity Systems, Vital Systems, High Integrity Functions and Vital Functions (e.g. safety proving, Round Train Circuit).

4.3.4.8 **Bogie Frame**

4.3.4.8.1 **Bogie Frame Static Testing**

The Contractor shall undertake static testing on a strain gauged bogie to confirm that all requirements are satisfied. Strain gauges shall be placed in any area where the computed stress level is greater than 80% of the yield stress or the 0.2% proof stress of the material, and in other locations determined either by the Project Manager or by the Contractor.

4.3.4.8.2 **Bogie Frame Fatigue Test**

The Contractor shall undertake accelerated fatigue life testing on one bogie frame. The number of cycles for the test spectrum shall not be less than the equivalent of 25% of the specified design life of the bogie. Details of testing are subject to approval by the Project Manager.

4.3.4.9.1 **Cold Testing**

The Contractor shall undertake climatic cold testing of:

(a) traction equipment including all components, covers and air in-take exhaust ports in addition to traction motors and bogies (including inter-connecting services);

(b) a complete pneumatic system including compressors, brakes, air reservoirs, pneumatic operators and interconnecting services;

(c) cab and saloon heating system; and

(d) cab and saloon water and draught proofing, to simulate the Train travelling at speed.

4.3.4.9.2 **Hot Testing**

The Contractor shall undertake climatic hot testing of:

(a) cab air-conditioning system; and

(b) saloon pressure ventilation system.

4.4 THE TRACKSIDE EQUIPMENT TEST DOCUMENTATION

4.4.1 Test and Inspection Plan

The test and inspection plan for the Trackside Equipment, in conjunction with the quality plan, shall contain sufficient detail to demonstrate that tests and inspection proposed ensure that the final deliverables fully meet the requirements of this Contract.

4.4.2 Test and Inspection Schedules for the Trackside Equipment

(a) The Contractor shall compile test and inspections schedules for the Trackside Equipment for all the tests and inspections detailed in the test and inspection plan and all test and inspections schedules shall document:

(i) the purpose and nature of the tests and inspections;

(ii) the procedure to be used;

(iii) the instrumentation required;

(iv) the expected results and tolerances allowed; and

(v) objective pass and fail criteria.

(b) All tests shall be carried out only in accordance with test and inspection schedules produced by the Contractor and approved by the Project Manager. The test and inspection schedules shall ensure that testing or inspection is carried out in accordance with the appropriate standards and in a safe manner.

(c) Should the Project Manager believe that any test or part of a test performed did not meet the test schedule requirements, the test or part of the test shall be repeated, at no charge to the Company, until it is performed to the Project Manager's satisfaction.

(d) Individual test and inspection schedules shall be submitted to the Project Manager no less than 25 Working Days before the test or inspection is due to take place to allow the Project Manager to satisfy himself that the tests or inspections are adequate in all respects. The Project Manager shall return reviewed test and inspection schedules no less than 10 Working Days before any test or inspection. An agreed test and inspection schedule shall be made available to the Project Manager 5 Working Days before any test or inspection.

4.4.3 **Test Reports and Results for Trackside Equipment**

The Contractor shall provide test reports for Factory Acceptance Tests, Type Tests and Site Acceptance Tests undertaken to the Project Manager. Test reports submitted shall contain the following information as a minimum:

(a) objectives;

(b) method;

(c) expected results;

(d) pass/fail criteria;

(e) test results - comparison with expected results and pass/fail criteria;

(f) of test configuration associated drawings and documentation;

(g) reference drawings and documentation;

(h) the test equipment calibration records;

(i) equipment inventory record;

(j) general certification:

(i) certificates of conformity as applicable;

(ii) approved concessions and deviations;

(iii) fault record sheet and list of replaced and repaired items;

(iv) approved testing authority certification;

(k) factory acceptance test procedures and results;

(l) Site electrical testing procedures and results; and

(m) Site visual inspection procedures and results.

The test result sheets shall include an area on each sheet to record comments, observations or details of tests/inspections together with a signature and date block for the Company's and Contractor's designated test representative.

Where tests are failed, the test result sheets shall include a section which records the results of the repeated tests and acceptance signature and date blocks.

4.5 CATEGORIES OF TESTS FOR TRACKSIDE EQUIPMENT

4.5.1 General

4.5.1.1 The Contractor shall perform tests and inspection to satisfy the Project Manager that the Equipment is fit for purpose and in accordance with this Contract.

4.5.1.2 The Project Manager reserves the right to require all materials to be tested at the Contractor's expense to ensure they meet the specified standards.

4.5.1.3 Upon completion of all tests, the Contractor shall remove all temporary connections, devices and test accessories and restore the equipment or site installation to a final condition acceptable to the Project Manager.

4.5.1.4 All power supplies, cabling and other equipment and materials required to complete the testing work shall be the responsibility of the Contractor.

4.5.2 General Test Requirements

4.5.2.1 Materials, cable, equipment, software, and interfaces shall be tested and inspected during construction and before delivery.

4.5.2.2 In all cases Equipment must operate correctly in all combinations of specified Radiated Interference, transients and surges. This interference can occur from Trains, Existing Trains, signalling, lighting, ticketing, lifts and escalator supplies, the Equipment itself, and cabling found in the railway environment. The traction, lifts, escalators, ticketing and associated equipment may utilise solid state or conventional control.

4.5.2.3 The tests shall be performed in accordance with the following requirements:

4.5.3 Type Tests for Trackside Equipment

(a) The function of a type test for Trackside Equipment is to demonstrate that the test specimen meets its specified performance under all specified operating and environmental conditions.

(b) No type testing shall be carried out without the type test schedule being approved.

(c) Type tests of components or items of equipment shall be carried out on the first-off production article. The Contractor may apply for an exemption for items supplied against an agreed standard and quality assurance programme.

Type tests shall be conducted on one single sample of each type of assembled cubicle and standalone equipment in accordance with the tests detailed below:

(a) temperature and humidity as detailed in paragraph 4.5.9.1;

(b) vibration and shock as detailed in paragraph 4.5.9.2;

(c) Radiated Interference as detailed in paragraph 4.5.9.3;

(d) power supply interference as detailed in paragraph 4.5.9.4;

(e) power supply variation as detailed in paragraph 4.5.9.5;

(f) performance tests including software as detailed in paragraph 4.5.9.8;

(g) visual inspection as detailed in paragraph 4.5.9.9.

The performance tests in (f), shall be conducted for each of tests (b) (c), in conjunction with tests (d) and (e).

4.5.4 Routine Tests for Trackside Equipment

Routine tests for Trackside Equipment demonstrate that defined parameters for particular equipment have been correctly reproduced. All items of equipment shall

undergo routine tests or inspections as appropriate to their function on every production item.

On completion of the environmental tests, routine tests shall be performed on all assembled cubicles and stand alone equipment units in accordance with the tests detailed below:

(a) insulation resistance as detailed in paragraph 4.5.9.6;

(b) visual inspection as detailed in paragraph 4.5.9.9;

(c) soak test as detailed in paragraph 4.5.9.7;

(d) power supply variation as detailed in paragraph 4.5.9.5;

(e) performance test as detailed in paragraph 4.5.9.8.

The performance tests in (e) shall be conducted during test (c) and in conjunction with test (d).

4.5.5 Production Tests

Production Tests on Trackside Equipment are to be conducted on individual equipment modules including equipment spare parts in accordance with the manufacturer's standard tests. These tests will not normally be witnessed by the Company but certificates of conformity will be submitted to the Project Manager by the Contractor.

All production test documentation shall be made available at the Contractor's premises for review by the Project Manager.

4.5.6 Factory Acceptance Tests

Factory acceptance tests for Trackside Equipment shall be performed on the system or the sub-system assemblies before delivery to the Company. The scope of the tests

shall prove the functionality and correct interfacing of the various elements of a whole or part system or sub-system assembly.

On completion of the production and environmental tests, factory acceptance tests shall be conducted on representative part or parts of each system to demonstrate all system integration aspects and the complete functioning to specification of the overall system, as detailed below:

(a) soak test as detailed in paragraph 4.5.9.7;

(b) performance test as detailed in paragraph 4.5.9.8;

(c) visual inspection as detailed in paragraph 4.5.9.9.

The performance tests in (b) above shall be conducted during test (a) above and on completion.

The factory acceptance tests shall include both the Trainborne Equipment and the Trackside Equipment.

The Contractor shall also demonstrate the length of time and technique necessary to carry out a satisfactory repair on each of a number of agreed faults to the satisfaction of the Project Manager.

The Project Manager reserves the right to re-initialise the 24 hours soak test if he considers from the test result data that the equipment performance to be unsatisfactory.

No additional program or data shall be fed into the system during testing except with the approval of the Project Manager. Following any such changes, a printout may be required to determine the contents of specified storage locations.

4.5.7 Site Inspections and Tests

The Contractor shall undertake tests as defined in paragraph 4.5.10.

4.5.8 **Acceptance of Delivery Tests**

The Trackside Equipment Acceptance of Delivery Tests, shall be a set of Site inspections and tests as agreed between the Contractor and the Project Manager in accordance with Clause 9.

4.5.9 **Elements of Various Tests - Trackside Equipment**

4.5.9.1 **Temperature and Humidity**

Temperature and humidity tests shall be conducted for equipment installed within communications equipment rooms and at other external locations in accordance with the requirements of Company Standard S&CSE-SE1015-A1, Sections 3 and 4.

4.5.9.2 **Vibration and Shock**

Vibration and shock tests shall be conducted in accordance with Section 5 of Company Standard S&CSE-SE1015-A1.

4.5.9.3 **Radiated Interference and Susceptibility**

(a) All equipment shall comply with all appropriate EEC Directives on EMC including but not limited to 89/336/EEC and 91/263/EEC.

(b) Specific requirements are detailed in sections 9.1.9.2 and 9.4 of Company Standard S&CSE-SE1015-A1 and Schedule 6, Part A.

(c) The Contractor shall test the equipment to the most onerous of the above requirements.

(d) Additional guidance on the applicable EMC Emission and Immunity Tests are contained in Document RA 227 published by the Radio Communications Agency.

4.5.9.4 **Power Supply Interference**

Power supply interference tests shall be conducted in accordance with section 9.3 of Company Standard S&CSE-SE1015-A1.

4.5.9.5 **Power Supply Variation**

Power supply variation tests shall be conducted in accordance with section 8.0 of Company Standard S&CSE-SE1015-A1.

4.5.9.6 **Insulation Test**

Each circuit intended for connection to AC supply circuits, unearthed DC supplies, current or voltage transformers, shall withstand 2kV rms, 50Hz, applied for 1 minute. This voltage shall be applied between:

(a) the individual circuits of this type; and

(b) each circuit of this type and all other circuits including earth. These other circuits may be strapped together electrically for the purpose of this test.

The above test shall be followed by the measurements of insulation resistance at 500 Volts DC. The insulation values shall not be less than 20 mega ohms when measured between:

(a) the opposite ends of each circuit with all contacts in the closed position; and

(b) both ends of each circuit to earth with all contacts in the closed position.

Where components are not designed to withstand such levels, alternative levels shall be submitted to the Project Manager for approval.

4.5.9.7 **Soak Test**

(a) Equipment shall be set up in a manner to simulate normal operating conditions, switched on, and allowed to operate continuously for a minimum period of 24 hours.

(b) For the factory acceptance tests described in paragraph 4.5.6, the duration of the soak test shall be a minimum of 24 hours.

4.5.9.8 **Performance Tests**

(a) Performance tests shall consist of a comprehensive series of measurements of the characteristics of the Equipment to check that its performance is in accordance with the functional requirements of the particular Equipment concerned, including all the requirements of Schedule 6

(b) Throughout the tests the Equipment must be carrying out its usual function, operating in a self test mode or carrying out a special test cycle.

(c) During the test, measurements and observations shall be made to prove stability, freedom from drift, and capability of operating without frequent attention.

(d) All failures of components and failures due to workmanship or construction shall be recorded and evidence produced that they are not due to inherent faults of design or manufacturing technique, and further, that the failure rate is not excessive, having regard to the requirements of the Schedule 6

(e) All failures shall be rectified by the Contractor, unless otherwise agreed with the Project Manager.

4.5.9.9 **Visual Inspection**

(a) Visual inspection shall be carried out by the Contractor in accordance with an inspection procedure to ensure that the Equipment, cables and materials are of sound construction and, so far as can be ascertained, meet the requirements of Schedule 6.

(b) The inspection will identify any deficiencies in the assembly, build and wiring of the Equipment with particular regard to ensuring that a high standard of workmanship is achieved and that the requirements for safety, maintainability, access, labelling and expansion etc., have been properly adhered to in accordance with this Contract.

(c) Discrepancies shall be rectified by the Contractor prior to commencing or continuing the acceptance tests.

(d) The Contractor shall make good all damage and replace any damaged equipment as soon as practicable and without impact on the overall programme.

(e) Where the Equipment is interfaced to facilities provided and installed by others the Contractor shall perform, at his expense, an inspection of these facilities to ensure their suitability. All deficiencies shall be brought to the immediate attention of the Project Manager.

(f) All such inspection shall be performed so as to allow sufficient time for any deficiencies to be rectified without impinging upon the Contract Programme.

4.5.9.10 **Cable and Installation Material Tests**

4.5.9.10.1 Cables and installation materials shall be inspected and tested in accordance with the applicable Company Standards and the relevant British Standards or European Standards together with the requirements of Schedule 6. The Contractor shall not install any cable or installation materials until the relevant certification has been scrutinised by the Project Manager.

Subject to the submission by the Contractor of suitable test certification documentation the Project Manager may waive the requirement to conduct the testing at his sole discretion.

The sequence of tests for each cable type shall consist of a minimum of:

(a) testing by an approved testing laboratory applicable to a sample length of all cable batches of LSNH cable prior to type testing;

(b) type tests which shall be conducted on a cable sample at the manufacturers' works prior to bulk cable manufacture for each cable batch;

(c) routine tests, sample tests and electrical tests which shall be conducted during the course of manufacture; and

(d) final inspection and testing which shall be conducted prior to delivery of the cable from the manufacturers' works.

4.4.5.9.10.2 Tests will be performed for flammability, smoke emission and toxic fume emission.

4.5.9.10.3 Type tests shall include:

(a) all tests applicable to Company Standard SE 1000A;

(b) all electrical and other tests referred to in Schedule 6; and

(c) environmental and vibration tests.

4.5.9.10.4 Routine tests, sample tests and electrical tests relate to the standard tests which any manufacturer will conduct during the course of manufacture and shall include material tests, dimensional checks and electrical characteristics.

4.5.9.10.5 Final inspection and testing shall include:

(a) testing by the Company laboratory of a sample length of each batch of LSNH cable manufactured; and

(b) visual inspection and packaging on all cable batches.

4.5.10 **Site Acceptance Tests**

4.5.10.1 On completion of the installation work the complete works shall be fully inspected and tested including interfaces together with any cables or other facilities provided by the Company which completes the total system installation.

4.5.10.2 The scope of inspection and testing shall include the following test categories:

(a) electrical testing as described in paragraph 4.5.10.3;

(b) visual inspection as described in paragraph 4.5.10.4;

(c) in-station testing as described in paragraph 4.5.10.5;

(d) end to end testing as described in paragraph 4.5.10.6; and

(e) test run and stability testing as described in paragraph 4.5.10.7.

4.5.10.3 **Electrical Testing - Trackside Equipment**

This shall include the testing of all cables, equipment and materials within the equipment rooms and externally to meet the requirements of BS 7671, "Requirements for Electrical Installations, IEE Wiring Regulations - 16th Edition".

Also performance tests on all co-axial cables or other special cables to demonstrate that the electrical characteristics of the cables have remained within the specification.

4.5.10.4 **Visual Inspection**

This shall include a check that all equipment and cables within the equipment rooms and externally are installed in the correct location and the positions defined in the design documentation. Also see the visual inspection as detailed in paragraph 4.5.9.9 shall be carried out.

4.5.10.5 **In-Station Testing**

This shall consist of the performance testing of each individual site in accordance with the requirements of paragraph 4.5.9.8. These tests shall be conducted on completion of visual inspection and electrical testing described in paragraph 4.5.10.4 and 4.5.10.3 respectively.

4.5.10.6 **End to End Testing**

On completion of in-station testing, end to end testing shall be conducted to provide performance testing of equipment inter-linking two or more sites, in accordance with the requirements of paragraph 4.5.9.8, as appropriate.

The tests shall be conducted in a live situation with both Trackside Equipment and Trainborne Equipment activated.

4.5.10.7 **Test Run and Stability Testing**

(a) On completion of the end to end testing the Contractor shall be responsible for a 28 day test run. The test run is for the purpose of evaluation and shall serve to check the satisfactory operation of the equipment within its working environment and to instruct executive, operational and maintenance personnel. During this period the stability of the system characteristics shall be evaluated.

(b) If a total failure of any station sub-system occurs, the test run shall be cancelled until the equipment has been repaired. A fresh 28 day test run period shall begin.

(c) If a partial failure occurs at any station, the test run shall be halted until the equipment has been repaired. The test run shall then be resumed for the balance of 28 day period outstanding.

(d) If any further partial failure occurs subsequently within the remainder of the period, continuation of the tests shall agreed with the Project Manager.

4.5.10.7.1 **Test Run and Stability Testing: CCTV System**

(a) A total failure shall be defined as a failure to transmit a specification compliant picture to a Train in accordance with the transmission requirements specified in Schedule 6 Part B. Any interruptions in transmission of more than 3 seconds shall be considered as a total failure.

(b) A partial failure shall be defined as a failure to continuously transmit a picture to a Train while within a platform and until the Train is clear of the specified zone of operation. Any interruption of less than 3 seconds or degradation of the transmitted picture to a point where it does not comply with the performance requirements shall constitute a partial failure.

(c) The test run shall be conducted using at least 2 Trains.

(d) The Contractor shall demonstrate at stations with multiple platforms that the CCTV signals are received correctly as specified in Schedule 6, Part B using at least 2 Trains.

4.5.10.7.2 **Test Run and Stability Testing: Enhanced Existing VHF and Final UHF Trunked Radio System**

The method of test for both Enhanced Existing VHF Train Radio and the Final UHF Trunked Radio systems shall be agreed between the Contractor and the Project Manager.

4.6 DEPOT ENABLING WORKS TEST REQUIREMENTS

4.6.1 Testing Documentation

4.6.1.1 Test Plan

The test plan for the Enabling Works, in conjunction with the quality plan, shall contain sufficient detail to demonstrate that tests proposed ensure that the final deliverables fully meet the requirements of this Contract.

4.6.1.2 **Test and Inspection Schedules**

(a) The Contractor shall compile test and inspections schedules for the Enabling Works for all the tests and inspections detailed in the test and inspection programme and all test and inspections schedules shall document:

(i) the purpose and nature of the tests and inspections;

(ii) the procedure to be used;

(iii) the instrumentation required;

(iv) the expected results and tolerances allowed; and

(v) objective pass and fail criteria.

(b) All tests shall be carried out only in accordance with test and inspections schedules produced by the Contractor and approved by the Project Manager. The test and inspections schedules shall ensure that testing or inspection is carried out in accordance with the appropriate standards and in a safe manner.

(c) Should the Project Manager believe that any test or part of a test performed did not meet the test schedule requirements, the test or part of the test shall be repeated, at no charge to the Company, until it is performed to the Project Manager's satisfaction.

(d) Individual test and inspection schedules shall be submitted to the Project Manager no less than 25 Working Days before the test or inspection is due to take place to allow the Project Manager to satisfy himself that the tests or inspections are adequate in all respects. The Project Manager shall return reviewed test and inspection schedule no less than 10 Working Days before any test or inspection. An agreed test and inspection schedules shall be made

available to the Project Manager 5 Working Days before any test or inspection.

4.6.1.3 **Test Reports and Results**

The Contractor shall provide test reports for tests undertaken on the Enabling Works to the Project Manager. Test reports submitted shall contain the following information as a minimum:

(a) objectives;

(b) method;

(c) expected results;

(d) pass/fail criteria;

(e) test results - comparison with expected results and pass/fail criteria;

(f) the test circuit schematic, associated drawings and documentation;

(g) test and inspection result sheets;

(h) test and inspection certificate sheets;

(i) the test equipment calibration certificates;

(j) the system equipment or cable to be tested incorporating any unique serial number or identification system of such items (a cross-reference shall be provided to all associated test procedures and test result documents);

(k) certification:

(i) certificates of conformity;

(ii) approved concessions, deviations and waivers;

(iii) fault record sheet and list of replaced and repaired items;

(iv) approved testing authority certification (e.g. Company laboratory testing); and

(v) factory acceptance test procedures and results;

(vi) site acceptance test procedures and results;

(vii) installation and dimensional check procedures and results; and

(viii) development trial procedures and results.

(l) conclusion; and

(m) recommendations.

The test result sheets shall include an area on each sheet to record comments, observations or details of tests/inspections together with a signature and date block for the Company's and Contractor's designated test representative.

Where tests are failed, the test result sheets shall include a section which records the results of the repeated tests and acceptance signature and date blocks.

4.7 GENERAL TESTING REQUIREMENTS FOR ENABLING WORKS

4.7.1 General

4. 7.1.1 The Contractor shall perform tests and inspection to satisfy the Project Manager that the Enabling Works are fit for purpose and in accordance with this Contract. The Contractor shall carry out Factory Acceptance Tests, Installation Checks and Site Acceptance Tests as detailed in this paragraph 4.7 and paragraph 4.8 on all equipment which is to be installed as part of the Depot Enabling Works as specified in Schedule 6, Part I.

4.7.1.2 The Project Manager reserves the right to require all materials to be tested at the Contractor's expense to ensure they meet the specified standards.

4.7.1.3 Upon completion of all tests, the Contractor shall remove all temporary connections, devices and test accessories and restore the equipment or site installation to a final condition acceptable to the Project Manager.

4.7.1.4 All power supplies, cabling and other equipment and materials required to complete the testing work shall be the responsibility of the Contractor.

No additional programme or data shall be fed into the system during testing except with the approval of the Project Manager. Following any such changes, a printout may be required to determine the contents of specified storage locations.

4.7.2 **Categories of Test**

Materials, cable, equipment, software, and interfaces forming part of the Enabling Works shall be tested and inspected during manufacture, construction and before delivery.

In all cases equipment must operate correctly in all combinations of specified Radiated Interference, transients and surges. This interference can occur from Trains, Existing Trains, signalling, lighting, the equipment itself, and cabling found in the railway environment. These may utilise solid state or conventional control.

The test requirements shall fall into 4 categories:

(a) factory acceptance tests;

(b) installation and dimensional check; and

(c) site acceptance tests.

4.7.2.1 Factory Acceptance Tests

The Factory Acceptance Tests on Enabling Works shall be conducted on all assembled cubicles and stand-alone equipment to demonstrate all aspects of the system including all system integration aspects and the complete functioning of the system to the necessary specification. The Factory Acceptance Tests will comprise, without limitation, the following individual tests, unless the Project Manager agrees that they are not applicable to the equipment under consideration:

(a) vibration and shock test, as specified in paragraph 4.8.1;

(b) radiated interference and susceptibility test, as specified in paragraph 4.8.2;

(c) power supply interference test, as specified in paragraph 4.8.3;

(d) power supply variation test, as specified in paragraph 4.8.4;

(e) performance test, as specified in paragraph 4.8.5;

(f) visual Inspection test, as specified in paragraph 4.8.6;

(g) insulation test, as specified in paragraph 4.8.7;

(h) cable and installation materials test, as specified in paragraph 4.8.8;

(i) electrical test, as specified in paragraph 4.8.9; and

(j) production tests, as specified in paragraph 4.8.10.

4.7.2.2 Installation and Dimensional Check

The installation and dimensional check on the Enabling Works will consist of a detailed dimensional check that all equipment, cables and installation materials have been installed in the locations defined in the design documentation. This check shall be undertaken prior to commencement of commissioning activities leading up to a Site Acceptance Test. The requirement for this check may be waived for an individual item of equipment following agreement with the Project Manager.

4.7.2.3 **Site Acceptance Test**

On completion of the installation of the equipment for the Enabling Works the complete system shall be fully inspected and tested including interfaces together with any cables or other facilities provided by the Company which completes the total system installation.

The Site Acceptance Test will comprise, without limitation, the following individual tests, unless the Project Manager agrees that they are not applicable to the equipment under consideration:

(a) performance test, as specified in paragraph 4.8.5;

(b) visual inspection test, as specified in paragraph 4.8.6;

(c) insulation test, as specified in paragraph 4.8.7;

(d) cable and installation materials test, as specified in paragraph 4.8.8;

(e) electrical test, as specified in paragraph 4.8.9;

(f) load test, as specified in paragraph 4.8.11;

(g) deflection test, as specified in paragraph 4.8.12;

(h) noise level test, as specified in paragraph 4.8.13;

(i) pressure test, as specified in paragraph 4.8.14;

(j) lighting level test, as specified in paragraph 4.8.15.

4.8 **DETAILED REQUIREMENTS FOR INDIVIDUAL TESTS FOR ENABLING WORKS**

4.8.1 **Vibration and Shock Test**

Vibration and shock tests shall be conducted in accordance with Section 5 of Company Standard S&CSE-SE1015-A1.

4.8.2 **Radiated Interference and Susceptibility Test**

(a) All equipment shall comply with all appropriate EEC Directives on EMC including but not limited to 89/336/EEC and 91/263/EEC.

(b) Additional guidance on the applicable EMC Emission and Immunity Tests are contained in Document RA 227 published by the Radio Communications Agency.

4.8.3 **Power Supply Interference Test**

Power supply interference tests shall be conducted in accordance with section 9.3 of Company Standard S&CSE-SE1015-A1.

4.8.4 **Power Supply Variation Test**

Power supply variation tests shall be conducted in accordance with section 8.0 of Company Standard S&CSE-SE1015-A1.

4.8.5 **Performance Test**

(a) Performance tests shall consist of a comprehensive series of measurements of the characteristics of the equipment to check that its performance is in accordance with the functional requirements of the particular equipment concerned, including all the requirements of Schedule 6

(b) Throughout the tests the equipment must be carrying out its usual function, operating in a self test mode or carrying out a special test cycle.

(c) During the test, measurements and observations shall be made to prove stability, freedom from drift, and capability of operating without the need for attention.

(d) All failures of components and failures due to workmanship or construction shall be recorded and evidence produced that they are not due to inherent faults of design or manufacturing technique, and further, that the failure rate is not excessive.

(e) All failures shall be rectified by the Contractor, unless otherwise agreed with the Project Manager.

4.8.6 **Visual Inspection Test**

(a) Visual inspection shall be carried out by the Contractor in accordance with an inspection procedure to ensure that the equipment, cables and materials are of sound construction and, so far as can be ascertained, meet the requirements of Schedule 6.

(b) The inspection will identify any deficiencies in the assembly, build and wiring of the equipment with particular regard to ensuring that a high standard of workmanship is achieved and that the requirements for safety, reliability, maintainability, access, labelling and expansion etc., have been properly adhered to in accordance with this Contract.

(c) Discrepancies shall be rectified by the Contractor prior to commencing or continuing the acceptance tests.

(d) The Contractor shall make good all damage and replace any damaged equipment as soon as practicable and without impact on the overall programme.

(e) Where the equipment is interfaced to facilities provided and installed by others the Contractor shall perform, at his expense, an inspection of these facilities to ensure their suitability. All deficiencies shall be brought to the immediate attention of the Project Manager.

(f) All such inspection shall be performed so as to allow sufficient time for any deficiencies to be rectified without impinging upon the Contract Programme.

4.8.7 **Insulation Test**

Each circuit intended for connection to AC supply circuits, unearthed DC supplies, current or voltage transformers, shall withstand 2kV rms, 50Hz, applied for 1 minute. This voltage shall be applied between:

(a) the individual circuits of this type; and

(b) each circuit of this type and all other circuits including earth. These other circuits may be strapped together electrically for the purpose of this test.

The above test shall be followed by the measurements of insulation resistance at 500 Volts DC. The insulation values shall not be less than 20 mega ohms when measured between:

(a) the opposite ends of each circuit with all contacts in the closed position; and

(b) both ends of each circuit to earth with all contacts in the closed position.

Where components are not designed to withstand such levels, alternative levels shall be submitted to the Project Manager for approval.

4.8.8 **Cable & Installation Materials Test**

Cables and installation materials shall be inspected and tested in accordance with the applicable Company Standards and the relevant British Standards or European Standards together with the requirements of Schedule 6.

Subject to the submission by the Contractor of suitable test certification documentation the Project Manager may waive the requirement to conduct the testing at his sole discretion.

4.8.9 **Electrical Test**

This shall include the testing of all cables, equipment and materials to meet the requirements of BS 7671, "Requirements for Electrical Installations, IEE Wiring Regulations - 16th Edition".

Also performance tests on all co-axial cables or other special cables to demonstrate that the electrical characteristics of the cables are within the specification.

4.8.10 **Production Tests**

The manufacturer's standard tests shall be conducted on individual equipment modules including equipment spare parts. These tests shall not normally be witnessed by the Company but test results or certificates of conformity will be submitted to the Project Manager by the Contractor.

All production test documentation shall be made available at the Contractor's premises for review by the Project Manager.

4.8.11 **Load Test**

All items of lifting or loading equipment shall be tested in accordance with Statutory Requirements and those of the British Standards.

4.8.12 **Deflection Test**

All items of lifting or loading equipment shall be tested in accordance with Statutory Requirements and those of the British Standards.

4.8.13 **Noise Level Test**

All items of equipment shall be tested in accordance with Statutory Requirements and those of the British Standards.

4.8.14 **Pressure Test**

All items of equipment shall be tested in accordance with Statutory Requirements and those of the British Standards.

4.8.15 Lighting Level Test

All items of equipment shall be tested in accordance with Statutory Requirements and those of the British Standards.

5. SITE MANAGEMENT

The Contractor shall provide all Protection including Protection Masters, Possession Masters and Look-out Men that are required to safely undertake and complete the works.

5.1 REQUIREMENTS FOR INSTALLATION

5.1.1 General

5.1.1.1 The Contractor shall store, deliver to site, unpack, erect, fix and install all equipment and materials which are to be supplied under this Contract.

5.1.1.2 Installation work shall be carried out to a high standard of workmanship.

5.1.1.3 Equipment, cables and materials shall be arranged to provide a convenient layout for operation and maintenance work.

5.1.1.4 All hardware and cables shall be firmly secured providing a safe, neat and tidy installation.

5.1.1.5 Damage to equipment and to existing Site facilities and accommodation shall be made good prior to completion of the installation or as otherwise required by the Project Manager.

5.1.1.6 All equipment areas shall be left in a clean and tidy condition and all surplus materials shall be removed from Site each night and after every shift.

5.1.1.7 The Contractor shall ensure by inspection of the Company documentation, where this is available, and Site investigation, as necessary, that suitable provision is

made for all the works required. The Contractor shall be responsible for the proper execution of the works, to the satisfaction of the Project Manager.

5.1.1.8 The Contractor shall be responsible for making Site inspections and investigations as may be necessary for the Contract Duration to ensure proper design, documentation and execution of the works. The appropriate documentation shall be agreed by the Project Manager before work commences upon any part of the Site including detailed method statements for all installation activities.

5.1.1.9 The Contractor shall afford full opportunity for the Project Manager to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Project Manager whenever any such work or foundations is or are ready or about to be ready for examination.

5.1.1.10 The Contractor shall uncover any part or parts of the works or make openings in or through the same as the Project Manager may from time to time direct and shall reinstate and make good such part or parts to the satisfaction of the Project Manager.

5.1.1.11 The drilling and tapping of the Site structure fabric such as the roof, steel support beams, tunnel segments, etc., is forbidden without the prior written agreement of the Project Manager. All fixings shall be made into solid structures and not into plaster or other such finishes. Threaded fastenings shall have either hexagonal, slotted or socket heads. "Phillips, Posidrive" or any variation of these types of heads shall not be used. No fixing other than those detailed within this Contract shall be used without the prior written agreement of the Project Manager.

5.1.2 Railway Operational Requirements

5.1.2.1 The Equipment shall be installed within the operational environment of a busy mass transit underground railway and all work within the Company operational areas shall comply with the provisions of Schedule 8 and project procedures listed in Schedule 6 Part J.

5.1.2.2 The installation, testing and commissioning works shall include works to be done outside periods of normal operational service. Times available for cable laying in the vicinity of the railway track will be restricted and access to station equipment rooms will only be permitted when accompanied by the authorised keyholder. Work during Engineering Hours will be involved.

5.2 SITE PREPARATION AND FINISHING DETAILS

5.2.1 Removal Of Redundant Equipment And Cables

5.2.1.1 General

The Contractor shall remove all redundant equipment, cables and materials prior to completion of the site acceptance testing of the works or as otherwise required by the Project Manager. All surfaces shall be made good on completion of the removal work.

5.2.1.2 Redundant Equipment

The Contractor shall dismantle, remove from Site and dispose of all accessible cable routing facilities and other equipment which has become redundant during the course of the work.

5.2.1.3 Redundant Cables

Redundant cables shall be disconnected from the source of supply and the termination point. A blue label shall be attached to both ends of the cable with the following information incorporated:

(a) date of disconnection;

(b) name of department/contractor disconnecting the cable;

(c) telephone number of contractor;

(d) source point of the cable;

(e) termination point of the cable.

The label shall remain attached to each end of the cable until the whole cable length has been removed. Cable disposal shall be subject to the approval of the Project Manager and shall be the responsibility of the Contractor.

5.2.2 [Not Used]

5.2.3 **Cutting and making good**

5.2.3.1 Where surface finishes are to be disturbed, written authority shall be obtained from the Project Manager prior to the work commencing, and shall be made good to the original standard or to an alternative standard acceptable to the Project Manager. Finishes shall be made good where conduit, wiring, trunking, etc. has been removed, altered or installed as part of the works.

5.2.3.2 All works affecting public areas finishes shall be approved prior to the commencement of the works by the Project Manager.

5.2.4**.** **Painting**

5.2.4.1 The Equipment, the Enabling Works, equipment for the Services, cable routing facilities and associated metalwork shall be painted in areas to which the public normally have access such as stairways, corridors, platforms and concourses, etc.

5.2.4.2 The paint shall conform to the Company's Code of Practice for Fire Safety of Materials and shall be sourced from a Company approved supplier.

5.2.4.3 The preparation of surfaces for coating shall be appropriate for that surface and local environment. The coatings shall provide a maximum total dry thickness of 160 µm.

5.2.4.4 Where on Site painting is required due care shall be taken not to mark the surrounding finishes and the paint shall be applied in a professional manner. Two coats of paint shall be applied, one well brushed into all crevices and indentations before erection (where applicable) and one applied when erection is complete.

5.2.4.5 Any excess painting applied to site structures shall be removed and the finishes shall be restored to the original condition.

5.3. CABLE STOCK RECORD

5.3.1 The Contractor shall maintain an up to date record for the purpose of cable traceability by recording all appropriate cable details on delivery to the Contractor's storage yard at the Depots and later when issued to a particular part of the Site.

5.3.2 Cable Storage

5.3.2.1 General

Cables shall be padlocked in a secure room or compound on delivery to a Depot or any other part of the Site, stored in order of size and length to facilitate easy location and cables without a protective sheathing shall be stored in dry conditions.

5.3.2.2 Temporary Cable Stores (Section 12 stations)

5.3.2.2.1 Temporary cables stores at stations to which Section 12 of the Fire Precautions Act applies shall conform to the requirements detailed below.

5.3.2.2.1.1 Stores shall only be positioned at the remote ends of the platforms away from exits and arranged so as not to restrict access to any adjacent rooms or cross passageways. Stores shall be located at least 2 metres from the platform edge.

5.3.2.2.1.2 These stores shall only be used for cable drum storage. A storage licence must be obtained from the Company in advance and displayed on each store. A copy of the Company's application form for such a licence is contained in the Appendix to this Schedule.

5.3.2.2.1.3 Construction shall consist of an angle iron frame similar to Dexion type racking, which shall be clad using a 9 mm fire resistant board. All butted joints in the cladding must be sealed by either using a fire resistant cement or fixing a strip of cladding astride the joint. Roof panels shall be pitched at an angle and the void between the station ceiling and store roof must be fenced off using wire mesh so as to prevent a build up of debris.

5.3.2.2.1.4 The door must be close fitting and the hinges fitted in a manner to be tamper proof. The door must have a 230 mm square transparent fire resistant and vandal proof panel set into it. Also the door shall have an enamel sign (150 mm x 300 mm) which shall be clearly marked "Temporary Store".

5.3.2.2.1.5 The cladding must be coated, both inside and out, using two coats of intumescent paint. Each coat shall have approximately density of 200 gm^{-2}.

5.3.2.2.1.6 Unevenness in the platform floor shall be overcome by a fillet of fire resistant cement placed around the bottom of the store. Any voids, detected by light entering the store, must be sealed using fire resistant cement to reduce the possibility of material being "poked through" into the store.

5.3.2.2.1.7 A notice must be fixed in a prominent position within the room, such that it will not be obscured when the room is being used, stating "Cable Drum Storage ONLY".

5.3.2.2.1.8 Graffiti must not be removed but must be painted over by the Contractor using intumescent paint only.

5.3.2.2.1.9 It shall be the responsibility of the Contractor's supervisor in charge of the construction to notify the station manager of its completion.

5.3.2.2.1.10 The Contractor shall remove its rubbish from around each store on a daily basis.

5.3.3 Cable Cutting

5.3.3.1 When cutting cables, the Contractor shall ensure that the cable jacks are serviceable and that adequate lifting resources are available.

5.3.3.2 As soon as the cable has been cut the correct sealing caps or tape shall be applied to the ends.

5.3.3.3 The cable ends shall be labelled with waterproof labels detailing the size and length of the cable and the start and destination of each end. The Contractor shall then update the cable stock record.

5.3.3.4 A waterproof identification label shall be attached to the middle of each cut length of cable. The label must include the following information:

(a) cable size;

(b) cable length;

(c) the drum from which the cable was cut; and

(d) destination.

5.4 ACCESS PROCEDURE - STATIONS, TRACK AND SUBSTATIONS

The Contractor shall note that no particular requested access can be guaranteed.

5.4.1 **Site Access Control**

5.4.1.1 **Co-ordination of Site Access**

The Project Manager will establish an access control management unit who will be responsible for the co-ordination of the Contractor's works with Northern Line Business Unit and other projects requiring access to the Northern Line.

5.4.1.2 **Contractors Site Access Requests**

The Contractor shall provide its access requirements to the Company in the programme prepared by it in accordance with paragraph 1.3.8 of this Schedule.

The Contractor shall submit formal requests in the appropriate forms samples of which are contained in the Appendix to this Schedule, as their works progress for track access, station access, access to sub-stations and, prior to the Transfer Date, the Depots, the Outstations, the Sidings and the Accommodation Properties.

5.4.2 **Track Access to Contractors**

5.4.2.1 The Contractor shall ensure that all staff working on the track or track-side hold the required Company certificates issued by the Company. All works must be carried out in accordance with the requirements outlined in Schedule 8.

5.4.2.2 The Contractor must take into consideration that it may not have the sole use of the area of track, to which it is given access. The Project Manager will inform the Contractor of others working in the same area or restrictions in access.

5.4.3 **Engineers' Trains**

The Contractor shall provide a detailed list of Engineers' Trains for the transport of materials and personnel which it proposes to use as part of its programme. The Contractor shall request such trains no less than ten weeks prior to the relevant work taking place by completing an Engineers' Train booking application form, a sample of which is contained in the Appendix to this Schedule. Six to eight weeks before the

Engineers' Train is due to run, confirmation will be provided by the Project Manager, along with the protection requirements.

5.4.4 **Access to Track-side (non-tunnel sections)**

5.4.4.1 The Contractor shall provide a programme of the detailed areas of track-side that it requires during Traffic Hours. This must detail start and finish dates for each section and scope of work to be carried out.

5.4.4.2 Six weeks prior to carrying out any works the Contractor shall provide the Project Manager with a completed request for track-side access during traffic hours application form, a sample of which is contained in the Appendix to this Schedule, along with approved method statement, safety plan and drawings.

5.4.4.3 Confirmation of the availability of the required access will be provided four weeks before the required start date.

5.4.5 **Access to Areas of Tunnel with Asbestos Contaminated Track Ballast**

5.4.5.1 The areas of tunnel where there is a possibility of track ballast being contaminated with asbestos are:

(a) Archway to East Finchley (both roads)

(b) Camden Town to Golders Green (both roads);

(c) Waterloo to Kennington (southbound); and

(d) Goodge Street to Warren Street (both roads)

5.4.5.2 Work can only be carried out in these tunnels if it does not require the disturbance of the track ballast. Any work that requires disturbance of the track ballast is only allowed to be carried out by specialist contractors approved by the

Company and licensed by the Health and Safety Executive. This work will require a minimum of six months' notice.

5.4.5.3 To carry out work in these tunnels that does not require disturbance of the track ballast, the Contractor must complete and submit a permit to work in the tube tunnels for areas known to contain asbestos form F52/C, a sample of which is contained in the Appendix to this Schedule. The complete form must be forwarded to the Project Manager one month before access is first required. The Project Manager shall return authorised permits to the Contractor at least five Working Days before the first access date. Permits are issued for a maximum of one month's duration only. Without an authorised Permit there will be no access into these running tunnels.

5.4.5.4 All of the Contractor's staff who gain access to the affected tunnels must sign a health surveillance record form F53/C, a sample of which is contained in the Appendix to this Schedule, and the Contractor must return the completed form within one month of the date for the finish of the permitted work shown on the relevant form F52/C to the Project Manager.

5.4.6 **Possession of the Track that requires the closure of Passenger Train services**

5.4.6.1 Four months prior to each proposed Possession date the Contractor must provide a detailed method statement and drawings of the works to be carried out during the Possession and programme of the works for the Possession period. This must be submitted to the Project Manager.

5.4.6.2 Three months prior to the proposed Possession date the Contractor's site manager will be required to attend a Possession meeting with the Project Manager to explain and answer questions about the proposed Possession. This meeting shall confirm or reject the requested Possession and shall define the particular protection arrangements for the Possession.

5.4.6.3 Final draft of Possession arrangements will be confirmed to the Contractor one month before the agreed Possession date.

5.4.7 **Station Access**

5.4.7.1 All access to Stations must arranged in accordance with Schedule 8.

5.4.7.2 The Contractor is not allowed to carry out any works at stations without approved (by the Project Manager) method statements, drawings and programme of the works to be carried out.

Survey works also requires a method statement and programme approved (by the Project Manager) prior to requesting access.

5.4.7.3 **Access to Stations during Engineering Hours**

5.4.7.3.1 Prior to any access the Contractor must provide for the Project Manager, at least four weeks before the required start date, a completed "Station/Platform Access Request Form", a sample of which is contained in the Appendix to this Schedule. Confirmation of access availability will be provided two weeks before the requested start date. The Contractor must take into consideration that it will not have sole access to the Station during Engineering Hours and prior access before start of Engineering Hours must in no way affect the Passengers' safety or access.

5.4.7.3.2 The Contractor must work within the limits of the approved method statement, safety plan, drawings and programme. Any deviation from those approved documents may result in the stopping of the works and the refusal of further access to the Contractor.

5.4.7.3.3 The Contractor shall make contact with the contact person named on the returned request form at least 24 hours before starting work on the site.

5.4.7.4 **Possession of a Station that requires the closure of the Station during normal Traffic Hours**

5.4.7.4.1 Four months prior to the proposed Possession date, the Contractor shall provide to the Project Manager a detailed method statement, safety plan, drawings and programme of work to be carried out.

5.4.7.4.2 Three months prior to the proposed Possession date the Contractor shall attend a Possession meeting with the Project Manager to explain and answer questions on the proposed Possession.

5.4.7.4.3 Final Possession arrangements will be confirmed one month before the Possession.

5.4.7.5 Access to Stations during Traffic Hours

5.4.7.5.1 No access will be allowed in stations during Traffic Hours in areas used by Passengers, and station staff, etc.

5.4.7.5.2 Access to stations during Traffic Hours in areas other than those referred to in paragraph 5.4.7.5.1 will require six weeks' notice before the proposed commencement of any works.

5.4.7.5.3 Notice of proposed access to be carried out as set out in paragraph 5.4.4 above.

5.4.8 **Access to Sub-Stations**

5.4.8.1 All access to live Company sub-stations must be carried out in accordance with the Company's Rule Book. The Contractor shall ensure that working within a sub-station or sub-station compound must be certificated by the Company in accordance with the Rule Book and must be under the supervision of a qualified person, who is in possession of approved (by the Project Manager) method statement, safety plan, drawings and programme of works.

5.4.8.2 **Safety Regulations**

Contractors' staff entering and working in a live sub-station must have a good working knowledge of The Health & Safety at Work Act 1974, The Electricity at Work Regulations 1989 and the Company's regulations on working in live sub-stations.

5.4.8.3 **Sub-Station Keyholder**

A keyholder is a person who has attended a sub-station competence course. He may act as protection for as many other persons to enter a sub-station as his entry permit will allow.

5.4.8.4 **Tester**

A sub-station tester is a person certified to test a sub-station following works being carried out by others. The tester must always be present when work is being carried out in a sub-station.

5.4.8.5 **Sub-Station Test Room Inspector**

The test room inspector must always be present when any commissioning works are being carried out in a sub-station.

5.5. USE OF TRAINS FOR CABLE LAYING

5.5.1 In carrying out any cable laying, the Contractor shall comply with, and procure that its sub-contractors comply with Schedule 8.

5.5.2 When unloading materials at intervals along the track staff, may travel on the flat car between unloading sites provided that they are seated and the Engineer's Trains operates at walking pace. The supervisor (Train Master) must be able to see that the safe operation of this takes place.

5.5.3 When running in cable from an Engineer's Train, it must be done as defined in the Rule Book, generally using one of the dedicated turn-table flat cars, deep well wagons or occasionally using an ordinary flat car with drums on secured cable jacks and in these cases staff can be on that flat car for the purpose of carrying out the cable running work. The list in paragraph 5.5.5 gives the maximum cable drum sizes for the dedicated flat car turn-table wagons (yellow, green and brown) and the deep well wagon.

5.5.4 If using one of the deep well wagons for the large cable drums, suitable arrangements must be made to protect the staff if they are needed on these wagons. The supervisor (Train Master) must position himself on the Engineer's Train where he can see the work in progress and also be in direct contact with the train guard.

5.5.5 **Cable Drum Sizes**

Car Type	Maximum Cable Drum Size		
	Width (m)	Diameter (m)	Area of Use
Yellow Turn-table	1.40	2.30	1,2
Yellow Turn-table	1.07	1.80	3
Green Turn-table	1.40	2.30	1,2
Green Turn-table	1.07	1.80	3
Brown Turn-table	1.40	2.30	1,2
Deep Well	1.37	2.28	1,2,3

1. Surface Areas
2. Sub-Surface Areas
3. Tube Areas

6. QUALITY ASSURANCE

Quality assurance on this Contract shall be carried out by the Contractor in accordance with Company Standard RSE/STD/022-Part 5 in respect of Trains and its principles applied in full to the Equipment and the Enabling Works. The Contractor shall develop a Contract specific quality assurance plan for approval by the Company in respect of the Services.

7. COMPLIANCE AUDITS

Audits shall be carried out by the Project Manager as a method or to ensure that the Contractor is complying with this Contract. The Contractor shall make available to the Project Manager such information as is required by the Project Manager to audit the following:

(a) safety;

(b) quality;

(c) design;

*/**(d) weight control;

(e) noise control;

(f) Train and Equipment performance;

(g) energy efficiency;

**(h) system optimisation;

**(i) diagnostics design;

(j) Materials Inventory;

**(k) reliability;

(l) testing procedures, compliance and schedules;

*(m) progress of the Enabling Works; and

(n) maintenance and life.

* These are not applicable to Trackside Equipment.

** These are not applicable to Enabling Works.

8. VARIATIONS

8.1 General

8.1.1 The procedure set out in this paragraph 8 applies in the following circumstances:

(a) if the Company requires the Contractor to make a variation to the Trains or any Train, the Existing Trains or any Existing Train, the Trainborne

Equipment or the Trackside Equipment (or any part thereof) or the Enabling Works or the New Equipment (or any part thereof) or to vary the scope of work required by, or reasonably to be inferred from, this Contract or the Real Property Documents (a ***Required Variation***);

(b) if the Company is considering requiring the Contractor to make a variation to the Trains or any Train, the Existing Trains or any Existing Train, the Trainborne Equipment or the Trackside Equipment (or any part thereof) or the Enabling Works or the New Equipment (or any part thereof) or to vary the scope of work required by, or reasonably to be inferred from, this Contract or the Real Property Documents (a ***Company Proposed Variation***); or

(c) if the Contractor requires the Company to consider a proposal made by the Contractor to make a variation to the Trains or any Train, the Existing Trains or any Existing Train, the Trainborne Equipment or the Trackside Equipment (or any part thereof) or the Enabling Works or the New Equipment (or any part thereof) or to vary the scope of work required by, or reasonably to be inferred from, this Contract or the Real Property Documents (a ***Contractor Proposed Variation***).

8.1.2 Unless the parties otherwise agree, no Variation shall take effect unless and until the parties have complied with the procedure set out in this paragraph 8.

8.1.3 The Contractor shall be responsible for ensuring that it has received all relevant forms from the Project Manager before any Variation is made or carried out.

8.1.4 The Company may issue a Notice of Required Variation or Notice of Company Proposed Variation and the Contractor may issue a Notice of Contractor Proposed Variation, at any time during the Contract Duration.

8.1.5 On the issue or receipt by the Project Manager of any Notice of Variation and prior to the issue of any Notice of Contractor Proposed Variation (on receipt by the Project Manager of a notification from the Contractor pursuant to paragraph 8.4.1), the Project Manager shall allocate a unique number to the potential Variation (which he shall notify to the Contractor) and he shall also maintain a sequentially numbered register of all potential and actual Variations. All subsequent correspondence between the parties in relation to any potential or actual Variation shall bear the allocated number.

8.2 Company Proposed Variations

8.2.1 In the event that the Company is considering requiring the Contractor to carry out a Company Proposed Variation, the Project Manager shall complete a Notice of Company Proposed Variation (other than the attachment thereto) specifying the Company Proposed Variation and shall deliver two copies of such notice to the Contractor.

8.2.2 Within 28 days of receipt of a Notice of Company Proposed Variation (or such other period as is specified therein), the Contractor shall complete one copy of the Notice of Company Proposed Variation (including the attachment thereto) and return the completed notice to the Project Manager.

8.2.3 Within 28 days of receipt of a completed Notice of Company Proposed Variation in accordance with paragraph 8.2.2, the Project Manager shall:

(a) if he is satisfied in all respects with the Contractor's response, complete, and issue to the Contractor, a Variation Order in respect of the Company proposed Variation which Variation Order shall specify:

(i) the Company Proposed Variation;

(ii) the cost of the Company Proposed Variation;

(iii) whether the Company elects to pay such cost in accordance with paragraph 8.6.2(a) or (b);

(iv) if the Company elects to pay such cost in accordance with paragraph 8.6.2(b), the date on which the relevant amount shall be deemed to be incurred by the Notional Lessors (as defined in Part I of Section 1 of Part B of Schedule 10) so that the Expenditure Schedule shall be treated as varied accordingly for the purposes of the production of all relevant cash flows pursuant to Part B of Schedule 10 and in accordance with paragraph 3.2(e)(ii) of Part I of Section 1 of Part B of Schedule 10 (in the case of a Variation to the Trains), paragraph 2.2(e)(ii) of Part I of Section 2 of Part B of Schedule 10 (in the case of a Variation to the Equipment), or paragraph 2.2(e)(ii) of Part I of Section 3 of Part B of Schedule 10 (in the case of a Variation to the Enabling Works); and

(v) the extension of time (if any) granted to the Contractor;

(b) if he is not satisfied with any part of the Contractor's response, require the Contractor to reconsider such part and, within 14 days of receipt of such a request, the Contractor shall make a further proposal to the Company in respect thereof. On receipt of such further proposal, this paragraph 8.2.3 will apply as if the Project Manager had received a Notice of Company Proposed Variation; or

(c) notify the Contractor in writing that the Company does not require the Contractor to carry out the Company Proposed Variation.

8.2.4 On receipt of a Variation Order pursuant to paragraph 8.2.3(a), the Contractor shall carry out the works specified in the Variation Order within the period specified therein.

8.3 Required Variations

8.3.1 In the event that the Company requires the Contractor to carry out a Required Variation, the Project Manager shall complete a Notice of Required Variation (other than the attachment thereto) specifying the Required Variation and shall deliver two copies of such notice to the Contractor.

8.3.2 On receipt of a Notice of Required Variation, the Contractor shall:

(a) as soon as reasonably practicable commence carrying out the work specified therein and may incur costs up to an amount specified in such Notice on a "price to be agreed basis" provided that it shall not incur any further costs above such amount in carrying out such work without prior authorisation from the Project Manager; and

(b) within 28 days of receipt thereof (or such other period as is specified in the Notice of Required Variation) complete one copy of the Notice of Required Variation (including the attachment thereto) and return the completed notice to the Project Manager.

8.3.3 Within 28 days of receipt of a completed Notice of Required Variation in accordance with paragraph 8.3.2(b), the Project Manager shall:

(a) if he is satisfied in all respects with the Contractor's response, complete, and issue to the Contractor, a Variation Order in respect of the Required Variation which Variation Order shall specify:

(i) the Required Variation;

(ii) the cost of the Required Variation;

(iii) whether the Company elects to pay such cost in accordance with paragraph 8.6.2(a) or (b);

(iv) if the Company elects to pay such cost in accordance with paragraph 8.6.2(b), the date on which the relevant amount shall be deemed to be incurred by the Notional Lessors (as defined in Part I of Section 1 of Part B of Schedule 10) so that the Expenditure Schedule shall be treated as varied accordingly for the purposes of the production of all relevant cash flows pursuant to Part B of Schedule 10 and in accordance with paragraph 3.2(e)(ii) of Part I of Section 1 of Part B of Schedule 10 (in the case of a Variation to the Trains), paragraph 2.2(e)(ii) of Part I of Section 2 of Part B of Schedule 10 (in the case of a Variation to the Equipment), or paragraph 2.2(e)(ii) of Part I of Section 3 of Part B of Schedule 10 (in the case of a Variation to the Enabling Works); and

(v) the extension of time (if any) granted to the Contractor.

(b) if he is not satisfied with any part of the Contractor's response, require the Contractor to reconsider such part and, within 14 days of receipt of such a request, the Contractor shall make a further proposal to the Company in respect thereof. On receipt of such further proposal, this paragraph 8.3.3 will apply as if the Project Manager had received a Notice of Required Variation; or

(c) notify the Contractor in writing that the Company does not require the Contractor to carry out the Required Variation.

8.3.4 On receipt of Variation Order pursuant to paragraph 8.3.3(a), the Contractor shall complete the works specified in the Variation Order within the period specified therein.

8.3.5 If the Project Manager gives notice to the Contractor pursuant to paragraph 8.3.3(c), the Contractor shall, provided that it complies with the claims procedure set out in Clause 33, be entitled to make a claim to recover from the Company any costs that it was authorised to incur in accordance with paragraph 8.3.2(a) (which shall include the amount specified in the initial Notice of Required Variation) and which were properly incurred by it prior to receipt of a notice pursuant to paragraph 8.3.3(c) in carrying out any work in accordance with paragraph 8.3.2(a) (including any costs directly relating to the cancellation of any commitments entered into by the Contractor).

8.4 Contractor Proposed Variations

8.4.1 In the event that the Contractor requires the Company to consider a proposal that the Contractor carry out a Contractor Proposed Variation, the Contractor shall obtain from the Project Manager a number allocated in accordance with paragraph 8.1.5 and shall complete in full (including the attachment thereto), and deliver to the Project Manager, a Notice of Contractor Proposed Variation specifying, inter alia, the Contractor Proposed Variation.

8.4.2 Within 28 days of receipt of a Notice of Contractor Proposed Variation in accordance with paragraph 8.4.1, the Project Manager shall:

(a) if he is satisfied in all respects with the proposal made in the Notice of Proposed Variation, complete, and issue to the Contractor, a Variation Order in respect of the Contractor Proposed Variation which Variation Order shall specify:

(i) the Contractor Proposed Variation;

(ii) the cost of the Contractor Proposed Variation;

(iii) whether the Company elects to pay such cost in accordance with paragraph 8.6.2(a) or (b);

(iv) if the Company elects to pay such cost in accordance with paragraph 8.6.2(b), the date on which the relevant amount shall be deemed to be incurred by the Notional Lessors (as defined in Part I of Section 1 of Part B of Schedule 10) so that the Expenditure Schedule shall be treated as varied accordingly for the purposes of the production of all relevant cash flows pursuant to Part B of Schedule 10 and in accordance with paragraph 3.2(e)(ii) of Part I of Section 1 of Part B of Schedule 10 (in the case of a Variation to the Trains), paragraph 2.2(e)(ii) of Part I of Section 2 of Part B of Schedule 10 (in the case of a Variation to the Equipment), or paragraph 2.2(e)(ii) of Part I of Section 3 of Part B of Schedule 10 (in the case of a Variation to the Enabling Works); and

(v) the extension of time, if any, granted to the Contractor;

provided however that the Company shall not be bound to issue a Variation Order in relation to any Contractor Proposed Variation; or

(b) if he is not satisfied with any part of such proposal, require the Contractor to reconsider such part and, within 14 days of receipt of such a request, the Contractor shall make a further proposal in respect thereof. On receipt of such further proposal, this paragraph 8.4.2 will apply as if the Project Manager had received a completed Notice of Contractor Proposed Variation; or

(c) notify the Contractor in writing that the Company does not require the Contractor to carry out the Contractor Proposed Variation.

8.4.3 On receipt of a Variation Order pursuant to paragraph 8.4.2(a), the Contractor shall carry out the works specified in the Variation Order within the period therein.

8.4.4 If the Contractor Proposed Variation is a request that the Contractor not be required to comply with any provision of this Contract or the Real Property Documents (including, without limitation, any provision of Schedule 6, which may include changes in material, dimensions, performance or work methods), the Contractor shall in addition to completing a Notice of Contractor Proposed Variation also supply the following information in writing to the Project Manager (to the extent that such information is relevant):

(a) provision of Schedule 6 (including Chapter/Section number) which is the subject of the request;

(b) total number of items ordered by the Contractor in respect of this Contract and for spares;

(c) number of items covered by the request;

(d) full description, including drawing or sketch as appropriate, to allow technical assessment of the non-compliance;

(e) details of similar previous requests other than in connection with this Contract and the experience related to them;

(f) reason for requested non-compliance and the effect, if the request is agreed, of such non-compliance;

(g) corrective action taken or proposed to prevent recurrence.

8.4.5 If the Project Manager refuses to issue a Variation Order in respect of any Contractor Proposed Variation, the Contractor shall not be entitled to claim any additional payment from the Company or any extension of time in respect of the performance of its obligations under this Contract or the Real Property Documents (as the case may be) unless this Contract expressly provides otherwise.

8.5 Financial Adjustments

8.5.1 In the event that the operation of any of the provisions of this Contract (other than the foregoing provisions of this paragraph 8) will result in an adjustment to the Existing Train Service Payments and/or the Usage Payments, the Project Manager shall allocate a unique number to such adjustment (which he shall notify to the Contractor) and he shall also maintain a sequentially numbered register of all adjustments. All subsequent correspondence between the parties in relation to any such adjustment shall bear the allocated number.

8.6 Payment for Variations

8.6.1 In completing any Notice of Variation, the Contractor shall, in determining the cost of the Variation specified therein:

(a) in respect of labour costs:

(i) if the proposed Variation is to a Train or Trains, or an Existing Train or Existing Trains, or the Equipment, use the rates set out in paragraphs 9.2, 9.3 and 9.4 (subject to indexation in accordance with paragraph 9.1) applicable to the proposed Variation; or

(ii) if the proposed Variation is to the Enabling Works, use the categories of rates set out in paragraphs 9.5 and 9.6 applicable to the proposed Variation and the rates provided by the Contractor for such categories

pursuant to paragraph 1 of Section 2 of Part E of Schedule 10 (subject to indexation in accordance with paragraph 9.1);

provided that in the event that a rate is not identified in paragraph 9 for the work (or any part thereof) contemplated by the proposed Variation, the Contractor shall use rates based upon published industry sector information such as that provided by trade associations or the Central Statistical Office; and

(b) in respect of the cost of materials or consumables:

(i) if the proposed Variation is to the Enabling Works, use the categories of rates set out in paragraphs 9.5 and 9.6 applicable to the proposed Variation and the rates provided by the Contractor for such categories pursuant to paragraph 1 of Section 2 of Part E of Schedule 10 (subject to indexation in accordance with paragraph 9.1); and

(ii) the Contractor shall include in any proposal quotations from any relevant sub-contractor.

8.6.2 In completing the attachment to any Notice of Variation, the Contractor shall specify the total cost of carrying out the relevant Variation and shall provide such information as the Company requires to enable it to determine whether to pay for such Variation in accordance with paragraph 8.6.2(a) or (b). If the Company is responsible for payment of such cost and a Variation Order is issued in respect thereof, the Company shall have the option (at its absolute discretion) of paying such cost:

(a) as a lump sum payment on the next date on which it makes a Usage Payment or Existing Train Service Payment (as the case may be) after the work specified in the Variation Order has been completed to the Train Manufacturer (if the cost is to be incurred in the Delivery Period or, if the Variation is in

respect of Equipment, if the cost is incurred prior to the second anniversary of the Final Acceptance of Delivery Date) or to the Contractor (otherwise) or, where the cost is incurred by the Contractor over time, as a supplemental payment to the Existing Train Service Payments or the Services Element of the Usage Payment (as the case may be); or

(b) by way of a supplemental payment of Usage Payment in accordance with (in respect of a Variation to the Trains) the provisions of Section 1 of Part B of Schedule 10, (in respect of a Variation to the Equipment) the provisions of Section 2 of Part B of Schedule 10 and (in respect of a Variation to the Enabling Works) the provisions of Section 3 of Part B of Schedule 10.

8.6.3.1 If the capital cost of carrying out any Variation during the Delivery Period or, if the Variation is in respect of Equipment, prior to the second anniversary of the Final Acceptance of Delivery Date would be such that the Purchase Price Limit (as defined in the Purchase Agreement) available to the Train Manufacturer to finance such Variation under the Purchase Agreement would be exceeded, the Contractor shall procure that the Train Manufacturer request from the Finance Parties an increase to the Purchase Price Limit to finance the carrying out of such Variation. In the event that the Finance Parties do not agree to such increase, the Contractor shall use its reasonable endeavours to procure offers for the financing of such Variation from any other financial institution with a credit rating at least equivalent to that of the Finance Parties on the date of this Contract on the same terms, mutatis mutandis, as the Trains Head Lease, the Equipment Head Lease or the Sub-Sub-Lease (as applicable), and provided that, if requested by the Company, such institution enters into a direct agreement with the Company on the same terms, mutatis mutandis, as the Trains Direct Agreement (in respect of Variations to the Trains or the Equipment) or the Depot Direct Agreement (in respect of Variations to the Enabling Works) and, failing which, on terms agreed with the Company and the Contractor.

8.6.3.2 In any case where the Contractor is unable, in respect of any Variation in the circumstances specified in paragraph 8.6.3.1 or any Variation to be made after the second anniversary of the Last Train Acceptance Date, to obtain financing, or offers for financing, on the terms set out in paragraph 8.6.3.1, the Contractor shall select, in consultation with the Company, three or more financial institutions which shall be invited to provide financing on terms agreed with the Company and the Contractor.

8.6.3 The Project Manager shall have the right to require the Contractor to provide him with any information or copies of supporting documentation in respect of pricing proposals or any other matter relevant to any Variation.

9. VARIATIONS RATES

9.1 Indexation

The rates set out in paragraphs 9.2, 9.3 and 9.4 were calculated as at September 1994. The Contractor shall be obliged to specify a list of each of the rates set out in paragraphs 9.5 and 9.6 pursuant to paragraph 1 of Section 2 of Part E of Schedule 10, such rates shall then be calculated back to September 1994 values for the purposes of this paragraph 9. In calculating the cost of carrying out any Variation, the Contractor shall be entitled to multiply any such rate by the Indexation Factor, where the relevant adjustment date is deemed to be the date of issue of the relevant Notice of Variation.

9.2 Service Rates for Variations

The rates set out in this paragraph 9.1 exclude overheads and consumable material prices and incorporate only the direct costs of employment and national health insurance, holiday, sickness allowances and training.

GRADE OF STAFF	SUB-CONTRACTED YES/NO	HOURLY RATE £
Mechanical Engineer - Design	No	27
Electrical Engineer - Design	No	27

Software Engineer - Design	No	27
Call Out Staff	No	22
Depot Mechanical Fitter - Skilled	No	22
Depot Mechanical Fitter - Semi-skilled	No	20
Depot Electrician	No	20
Electrical/Electronic Fitter	No	22
Depot Labourer	No	9

Train Cleaners	Yes	7to9
CCTV Technician	No	22
Train Radio Technician	No	22
CSDE Technician	No	22
PTI Technician	No	22
Operational Data Link Technician	No	22
Supervisors	No	24

Overtime Premiums		**Contractor Supply**	**Sub-Contractor**
Monday to Friday	0700-1800	0%	0%
Monday to Friday night	1801-0659	9%	16%
Saturday day	0700-1800	0%	0%
Sunday day	0700-1800	0%	0%
Saturday night	1801-0659	9%	16%
Sunday night	1801-0659	9%	16%
Bank Holiday	0700-1800	0%	0%

9.3 Equipment installation rates

DAY RATES			% PREMIUM FOR ENGINEERING HOURS WORKING	HOURLY RATE £
Operational Data Link Installation Personnel			50%	40
CSDE Installation Personnel			50%	40
PTI Installation Personnel			50%	40
CCTV Installation Personnel			50%	40
Train Radio Installation Personnel			50%	40
Cabling Installation Personnel			50%	40
Safety Supervision Personnel			50%	40
Monday to Friday	0700-1800	0%		
Monday to Friday night	1801-0659	0%		
Saturday day	0700-1800	0%		
Sunday day	0700-1800	0%		
Saturday night	1801-0659	0%		
Sunday night	1801-0659	0%		
Bank Holiday	0700-1800	0%		

9.4 Manufacturing rates

The rates set out in this paragraph 9.4 exclude fixed manufacturing overheads.

GRADE OF STAFF	**HOURLY RATE £**
TRAINS	
Mechanical Engineer - Design	27
Electrical Engineer - Design	27
Software Engineer	27
Mechanical Fitter - Skilled	15
Mechanical Fitter - Semi-skilled	15
Electrician	15
Electrical Fitter	15
Supervision	20
CSDE	40
CCTV	40
PTI	40
Operation Data Links	40
Train Radio	40

9.5 ENABLING WORKS RATES

9.5.1. General

9.5.1.1 Unless expressly stated otherwise the rates set out in this paragraph 9.5 are all inclusive, representing the total remuneration to the Contractor for the work described.

9.5.1.2 The Contractor shall supply all materials as may be required to complete the operations identified by the description of the types of work set out below.

9.5.1.3 Items against which no rates are entered shall be deemed to be included in other rates and prices and no separate payment shall be made in respect of such items.

9.5.1.4 The following abbreviations are used in this paragraph 9.5:

m	=	metres
m	=	square metres
m	=	cubic metres
mm²	=	square millimetres
nr	=	number
it	=	item
t	=	tonnes
kg	=	kilogram

9.5.1.5 Where descriptions refer to a range of sizes or weights, such as 10-20 kg/m, the range includes all sizes greater than the number given first and not exceeding the number given last.

9.5.1.6 All rates set out in this paragraph 9.5 shall be inclusive of any costs or charges associated with:

(a) scaffolding;

(b) plant and tools;

(c) electrical supplies and equipment for lighting, small power, compressed air, etc;

(d) all marking, banding, labelling, tagging and otherwise identifying the work installed by the Contractor;

(e) testing, including hydrostatic and pre-commissioning;

(f) cleaning, flushing and purging of equipment and pipework;

(g) protection;

(h) making good painting and coating whether initially applied by the Contractor or by others;

(i) mechanical and non-destructive testing

(j) welder and welding tests and qualifications, and all other quality requirements;

(k) painting to relevant specification on adjacent to field welds, to or between prefabricated pipe spools, or between joints of work subject to rate and work covered by lump sum;

(l) final documentation;

(m) indirect labour, supervision, management, overheads, home office costs, transportation, profit, etc;

(n) sheet piling, trench supports, general access requirements and all other general temporary works;

(o) dewatering, cooling/heating, lighting, etc;

(p) provision and installation of holding down bolts and all fixings; and

(q) design and all design documents including all submissions.

9.5.2 **Civil Work**

9.5.2.1 **Work adjacent to or remote from tracks**

Work carried out within 2 metres of a rail track is deemed to be adjacent to the tracks. Work more than 2 metres from any rail track is deemed to be remote from the tracks.

9.5.2.2 **Site Clearance**

The prices for Site clearance include for removal of vegetation and carting off Site. The price for removal of trees shall include for grubbing up of roots and carting all off Site.

9.5.2.3 **Earthworks**

9.5.2.3.1 The prices of excavation include for excavating through compacted fill material, clay, gravel, rubble, debris, made up ground and the like. Carting off site and double handling (where required) is shown separately.

9.5.2.3.2 Separate unit rate items are included for excavating rock, mass brickwork, reinforced and unreinforced concrete.

9.5.2.3.3 The prices/rates in paragraphs 9.5 and 9.6 include for any hand excavation it considers expedient or necessary for carrying out any Variation.

9.5.2.3.4 The rates in paragraphs 9.5 and 9.6 include for working around piles during excavation works and ensuring that no damage is caused to any piles. Any damage so caused must be made good by the Contractor at its own cost, and no claim will be considered on account of its not having done so.

9.5.2.3.5 Rates for trench excavation include for preparation of surfaces.

9.5.2.4 **Piling**

The prices include for boring, provision and placing of concrete, and the provision, bending and fixing of reinforcement.

9.5.2.5 **In Situ Concrete**

9.5.2.5.1 The prices for placing concrete bases, footings and ground slabs include for placing concrete in ground beams and cable trenches.

9.5.2.5.2 Rates for bolts include for casting in as detailed in Schedule 6.

9.5.2.6 **Excavation of Trenches**

Excavation of trenches for drainage is included in the rates for pipework.

9.5.2.7 **Concrete in Trenches**

The rates for concrete include for the provision and placing of concrete and all necessary formwork.

9.5.2.8 **Steelwork**

9.5.2.8.1 Steelwork shall be measured in tonnes and grouped by weight category for structural sections and by thickness for plate.

9.5.2.8.2 Where work is described as columns and beams, this refers to the structural element and not to the type of steel sections.

9.5.2.8.3 Rates for steelwork include for all types of sections except hollow sections.

9.5.2.8.4 Rates for steelwork include for all welding and bolting to steelwork and concrete.

9.5.2.8.5 Rates for steelwork include for nuts, bolts, washers, U-bolts, rods, clevises, turn buckles, I-beam welding attachments, welding lugs, lugs on bed plates, clevis plates.

9.5.3. UNIT RATES FOR CIVIL WORK

Item	Description	Unit	Rate (£)
9.5.3.1	**Site Clearance**		
	(a) Remove vegetation, bushes, etc., including existing structures	m	
	(b) Remove trees up to 0.9m girth	nr	
	(c) Remove trees of 0.9m girth and over	nr	
9.5.3.2	**Earthworks**		
9.5.3.2.1	**Earthfill**		
	Supply, place, compact and grade approved granular fill	m29	
9.5.3.2.2	**Excavation for Foundations inside the Depot Buildings (including Dewatering and Shoring where necessary)**		
	(a) Material other than topsoil, rock or artificial hard material:		
	- maximum depth 0.25-0.5m	m	
	- maximum depth 0.5-1.0m	m	
	- maximum depth 1.0-2.0m	m	
	- depths greater than 2m	m	
	(b) Rock or artificial hard material including		

plain concrete

- maximum depth 0.25-0.5m m
- maximum depth 0.5-1.0m m
- maximum depth great than 1m m

(c) Reinforced concrete

- maximum depth 0.25-0.5m m
- maximum depth 0.5-1.0m m

(d) Saw cut to a depth of 50mm m

9.5.3.2.3 **Excavation for Foundations Outside Depot Buildings Adjacent to Railway Tracks (including Dewatering and Shoring where necessary)**

Material other than topsoil, rock or artificial hard material:

- maximum depth 0.25-0.5m m
- maximum depth 0.5-1.0m m
- maximum depth 1.0-2.0m m
- depths greater than 2m m

9.5.3.2.4 **General Excavation Outside Depot Buildings Adjacent to Tracks (including Dewatering and Shoring where necessary)**

Unit Rate (£)

Material other than topsoil, rock or artificial hard material:

- maximum depth 0.25-0.5m m
- maximum depth 0.5-1.0m m
- maximum depth greater than 1.0m m

9.5.3.2.5 **Excavation for Foundations Outside Depot Buildings Adjacent to Railway Tracks (including Dewatering and Shoring where necessary)**

Material other than topsoil, rock or artificial hard material:

- maximum depth 0.25-0.5m m
- maximum depth 0.5-1.0m m
- maximum depth 1.0-2.0m m
- maximum depth greater than 2.0m m

9.5.3.2.6 **General Excavation Outside Depot Buildings Remote from Tracks (including Dewatering and Shoring where necessary)**

Material other than topsoil, rock or artificial hard material:

- maximum depth 0.25 - 0.5m m
- maximum depth 0.5 -1.0m m

Unit Rate (£)

-	maximum depth greater than 1.0m	m

9.5.3.2.7 **Excavation Ancillaries**

Preparation of excavated surfaces in material other than topsoil, rock or artificial hard material in depot buildings	m
Preparation of excavated surfaces in material other than topsoil, rock or artificial hard material outside depot buildings	m
Double handling of excavated material	m
Remove excavated material from site	m

9.5.3.2.8 **Filling**

To structures including trimming

-	granular fill up to 1m thick	m
-	granular fill up to 3m thick	m
-	granular fill over 3m thick	m

9.5.3.2.9 **Filling Ancillaries - Preparation of Filled Surfaces**

Material other than topsoil, rock or artificial hard material	m

9.5.3.2.10 **Disposal**

	Unit	**Rate (£)**

	(a)	Disposal of excess material from drainage, cable ducts and troughs, foundations inside depot buildings	m
	(b)	Disposal of excess material from drainage, cable ducts and troughs, foundations outside depot buildings	m
9.5.3.2.11	**Excavation, Handling and Disposal of Material containing deleterious substances (including all Safety Measures, Dewatering and Shoring where necessary)**		
	(a)	Adjacent to tracks	m
	(b)	Remote from tracks	m
9.5.3.3	**Piling**		
	(a)	Install bored cast in situ "mini" piles 6m long	Item
	(b)	Install bored cast in situ "mini" piles 10m long	Item
	(c)	Non-destructive integrity test for piles	Item
	(d)	Cut down top of piles to expose reinforcement	Item
	(e)	Dynamic test of piles	Item
9.5.3.4	**In Situ Concrete**		

Unit Rate (£)

9.5.3.4.1 **Provision of Concrete Ordinary - Prescribed Mix**

(a) Grade C15

- 20mm aggregate m

(b) Grade C30

- 20mm aggregate m

- 40mm aggregate m

9.5.3.4.2 **Placing of Mass Concrete**

Blinding - thickness not exceeding 100mm m

9.5.3.4.3 **Placing of Reinforced Concrete in Depot Buildings**

(a) Bases, footings, pile caps and ground slabs

- thickness not exceeding 150mm m

- thickness 150-300mm m

- thickness exceeding 300mm m

(b) Suspended slabs - thickness 150-300mm m

(c) Beams

- cross sectional area 0.1-0.25m m

- cross sectional area 0.25-1.0m m

Unit Rate (£)

9.5.3.4.4 **Placing of Reinforced Concrete Outside Depot Buildings Adjacent to Rail Track**

(a) Bases, footings, pile caps and ground slabs

- thickness not exceeding 150mm m
- thickness 150-300mm m
- thickness exceeding 300mm m

(b) Suspended slabs - thickness 150-300mm m

(c) Beams

- cross sectional area 0.1-0.25m m
- cross sectional area 0.25-1.0m m

9.5.3.4.5 **Placing Reinforced Concrete Outside Depot Buildings Remote from Rail Track**

(a) Bases, footings, pile caps and ground slabs

- thickness not exceeding 150mm m
- thickness 150-300mm m
- thickness exceeding 300mm m

(b) Suspended slabs - thickness 150-300mm m

(c) Beams

- cross sectional area 0.1-0.25m m

Unit Rate (£)

- cross sectional area 0.25-1.0m m

9.5.3.4.6 **Concrete Ancillaries**

9.5.3.4.7 **Formwork Rough Finish**

(a) Horizontal m

(b) Vertical m

(c) Voids:- Small depth not exceeding 0.5m nr

(d) Voids:- Large depth exceeding 0.5m nr

(e) Taper pockets in concrete 200mm sq at top x 400mm deep nr

9.5.3.4.8 **Formwork Fair Finish**

(a) Horizontal m

(b) Vertical m

9.5.3.4.9 **Reinforcement** - All cut, bent and fixed in position

(a) Mild steel bars

- Nominal size 8mm t
- Nominal size 10mm t
- Nominal size 12mm t

(b) High yield steel bars

- Nominal size 12mm t
- Nominal size 16mm t
- Nominal size 20mm t

Unit Rate (£)

		- Nominal size 25mm	t
	(c)	High yield steel fabric	
		- Nominal mass 3-4kg/m	m
		- Nominal mass 6-7kg/m	m

9.5.3.4.10 **Concrete Ancillaries - Joints**

	(a)	Formed surface plain	m
	(b)	Formed surface with filler	m
	(c)	Plastic or rubber waterstops	m
	(d)	Two part polysulphide sealant	m

9.5.3.4.11 **Concrete Accessories**

	(a)	Finishing of top surfaces	
		- Wood float	m
		- Steel trowel	m
	(b)	Concrete screed 75-150mm thick with 1mm surface finish	m
	(c)	Anchor bolt including anchor base plate, sleeve and grout-up to 20mm diameter	kg
	(d)	Anchor bolt including anchor base plate, sleeve and grout-over 20mm diameter	kg
	(e)	Drilled fixing - up to 16mm diameter	nr

Unit Rate (£)

	(f)	Drilled fixing - over 16mm diameter	nr
	(g)	Rolled steel angle (5-10kg/m) with tangs to form shelf angle for trench or pit covers, including grouting up	m
	(h)	Grouting under plates	m

9.5.3.5 **Building Work**

9.5.3.5.1 **Blockwork Walling**

	(a)	Dense, fairface concrete block 2.8 N/mm, incorporating mesh reinforcement to all joints, set in cement mortar (1:4); flush jointed as work proceeds	
		- 140mm thick	m
		- 190mm thick	m
	(b)	Dense, fairface concrete block 7.0 N/mm, incorporating mesh reinforcement to all joints, set in cement mortar (1:4); flush jointed as work proceeds	
		- 140mm thick	m
		- 190mm thick	m

9.5.3.5.2 **Built-in Pipes and Ducts in Walls**

	(a)	Pipes not exceeding 150mm dia	nr

Unit Rate (£)

	(b)	Ducts, area not exceeding 0.1m	nr
	(c)	Ducts, area exceeding 0.1m	nr

9.5.3.5.3 **Asphalt Roofing**

BS6577 Type R1162, covering limestone chippings in hot bit: building paper isolating membrane wood fibre ins. board underlay insulations batts laid to falls, hot bitumen bonded to vapour barrier with hot bit bonding underlay.

	(a)	20mm thick in 2 coats horizontal to concrete	m
	(b)	20mm thick in 3 coats skirtings to concrete, exp. metal mesh keys	m

9.5.3.5.4 **Plastering (all types) to Walls and Ceilings**

	(a)	Plaster: Carlite pre-mixed: floating coat of browning, 11mm thick, finishing coat of finish, 2mm thick: steel trowelled: internal	
	(b)	Work on brickwork or blockwork. Walls including all necessary beads, stops, etc.	m

9.5.3.5.5 **Painting**

	(a)	Water based epoxy on fair face walls	m
	(b)	Emulsion on plastered walls/partitions	m
	(c)	Painting to ceiling using water based epoxy	m

	Unit	**Rate (£)**

on soffits

9.5.3.5.6 **Tiling and Terrazzo Work**

Ceramic tiles: glazed: standard colour range: 3mm joints: fixing with adhesive: grouting with epoxy flexible compounds: internal

(a)	200 x 200 x 9mm units. Walls	m
(b)	200 x 200 x 9mm units. Floors	m
(c)	Skirting 200mm high: rounded top edge, covered junction with paving	m
(d)	Acid resistant tiling and fixing and grouting maximum thickness 50mm	m

9.5.3.5.7 **Glazing**

(a)	Single glazing in wired glass including glazing rails	m
(b)	Aluminium framed window 1m with top opening light	nr

9.5.3.5.8 **Internal Doors**

(a)	Proprietary metal doors single leaf stove enamel finish 1 hour fire resistant - including all furniture	nr
(b)	Semi-solid ply faced single leaf flush doors painted finish in softwood linings with	nr

Unit Rate (£)

		standard splayed round architraves both sides including all furniture	

9.5.3.5.9 **Skirtings**

		13 x 100mm splayed and rounded softwood	m

9.5.3.5.10 **Flooring**

	(a)	Floor screed: granolothic	m
	(b)	Extra over for 6mm thick upstand skirting, 75mm high	m
	(c)	Sand/cement screed to falls 50mm thick	m
	(d)	Vinyl floor, 3mm thick bonded and heat seam welded	m
	(e)	Extra over skirting vinyl, 150mm high	m
	(f)	Quarry tiles on waterproof screed	m

9.5.3.5.11 **Suspended Ceilings**

	(a)	600 x 600mm metal tray laying grid system with perforated stove enamel steel or aluminium tiles with acoustic insulation by Dampa or similar approved, including trimming around grills and lighting fittings as necessary	m
	(b)	600 x 600mm metal tray, stove enamel finish, suspended ceilings	m

	Unit	**Rate (£)**

9.5.3.5.12 **External Doors**

(a)	Single doors 900mm wide x 2100mm high steel hollow core construction 1 hour fire resistant including steel frames and vision panel	nr
(b)	Proprietary draft excluders to fit around train	nr
(c)	Mechanically operated roller shutter door for train entrance with local push button controls	nr

9.5.3.6 **Supply, Fabricate and Erect Steelwork**

9.5.3.6.1 **Columns and Beams**

-	Sections 20-50kg/m	t
-	Sections 51-100kg/m	t
-	Sections 101-150kg/m	t
-	Sections 151-200kg/m	t

9.5.3.6.2 **Plate**

-	Plate 6mm thick	t
-	Plate 8mm thick	t
-	Plate 10mm thick	t

Unit Rate (£)

	-	Plate 12mm thick	t
	-	Plate 15mm thick	t
9.5.3.6.3	**Channels and Angles**		
	-	Sections 0-10-kg/m	t
	-	Sections 10-20kg/m	t
9.5.3.6.4	**Galvanised Open Grid Flooring**		
	-	Up to 35 [ ] thick	m
	-	Up to 35 [ ] thick tread of stairs	nr
9.5.3.6.5	**Galvanised Durbar Plate Flooring**		
	-	Up to 6mm thick over plain	m
	-	6mm-12mm thick over plain	m
9.5.3.6.6	Made up steelwork assemblies of sections and plate		t
9.5.3.6.7	Galvanised handrails		m
9.5.3.7.	**Roads, Paving and Fencing**		
9.5.3.7.1	Flexible footpath to LUL requirements		m
9.5.3.7.2	Ash footpath complete to LUL requirements		m
9.5.3.7.3	**Concrete Pavements**		
	(a)	In situ concrete slabs C30 including sub base and construction joints	m

Unit Rate (£)

	(b)	Polythene membranes 0.25mm thick	m
	(c)	Contraction joints	m
	(d)	Expansion joints	m
	(e)	In situ concrete kerb 150mm high and 100mm wide - straight	m
	(f)	In situ concrete kerb 150mm high and 100mm wide - curved to radius not exceeding 12m	m

9.5.3.7.4 **Fencing and Gates**

	(a)	Security fence 3.0m high	m
	(b)	Security fence 4.5m high	m
	(c)	Double gates 4.5m wide, 3m high	nr
	(d)	Double gates 4.5m wide, 4.5m high	nr
	(e)	Personnel gates 900mm wide	nr

9.5.3.8. **Services**

9.5.3.8.1 **Plain Concrete Drains in Granular Surround**

	(a)	150mm dia drain - in trenches depth not exceeding 1.5m	m
	(b)	150mm dia drain - in trenches depth 1.5-2.0m	m

Unit Rate (£)

	(c)	225mm dia drain - in trenches depth not exceeding 1.5m	m
	(d)	150mm dia drain - in trenches depth 1.5-2.0m	m
9.5.3.8.2	**Perforated Concrete Drains in Granular Filter Material**		
	(a)	225mm dia drain - in trenches depth not exceeding 1.5m	m
	(b)	225mm dia drain - in trenches depth 1.5-2.0m	m
9.5.3.8.3	**Precast Concrete Manholes - Supply and Install Complete with 150mm Concrete Surround, Cover and Frame (including earthworks)**		
	(a)	900mm diameter downpipe complete with step irons:	
		- Depth not exceeding 1.5m	nr
	(b)	1050mm diameter downpipe complete with step irons:	
		- Depth not exceeding 1.5m	nr
		- Depth 1.5-2.0m	nr
		- Depth 2.0-2.5m	nr

Unit Rate (£)

9.5.3.8.4 **Precast Concrete Gullies**

	Concrete drainage gully complete with C1 grating and frame	Item

9.5.3.8.5 **Cable Ducts with 150mm thick Concrete Surround**

Nominal bore not exceeding 225mm

(a)	Straight lengths	m
(b)	90 swept bends	m

9.5.3.8.6 **Cable Ducts in Granular Surround**

Nominal bore not exceeding 225mm

(a)	Straight lengths	m
(b)	90 swept bends	m

9.5.4 **Unit Rates for Optic Fibre Cable Work**

(a)	Disconnect 96 fibre cable from splice box, reconnect and resplice fibres	Item
(b)	Disconnect 64 fibre cable from splice box, reconnect and resplice fibres	Item
(c)	Disconnect 20 fibre cable from splice box, reconnect and resplice fibres	Item
(d)	Disconnect 2 x 64 and one 20 fibre cable from splice box, demount splice box and	Item

Unit Rate (£)

	remount in new position, reconnect cables and resplice	
(e)	Disconnect 2 x 96 and one 20 fibre cable from splice box, demount splice box and remount in new position, reconnect cables and resplice	Item
(f)	Pull cable back and re-run on new route.	m
(g)	Lift cable from old run to new run, utilising remake loops to give slack but without disconnection	m
(h)	Supply and run new 20 fibre cable	m
(i)	Supply and run new 64 fibre cable	m
(j)	Supply and run new 96 fibre cable	m
(k)	Recover cable from run	m
(l)	Cap recovered cable and deliver to store	nr
(m)	For splicing and testing additional fibres in existing boxes after initial splicing and fibre testing has been completed:	
	- Fixed cost per site for access, set-up etc.	Item
	- Cost per fibre for splicing and testing	Item

	Unit	**Rate (£)**

For each item, two prices are required:

One assuming day work

One assuming engineering hours work

9.5.5 **Track Work**

The following items are to be used for the pricing of Variations. Any item left unpriced shall be deemed to be included elsewhere.

9.5.5.1 **Supply only the following**

(a)	Take up and remove from site track complete including running rails, conductor rails, sleepers, associated brackets, clips etc.	m
(b)	Extra over for taking up points and turnout	nr
(c)	Extra over for taking up scissor crossing	nr
(d)	Flat bottom rail, mass 56.4 kg/m; BS rail section Nr 113A	m
(e)	Conductor rails	m
(f)	Hardwood sleeper 250 x 2400 mm long	nr
(g)	Hardwood sleeper 250 x 2600 mm long	nr
(h)	Hardwood sleeper 250 x 2750 mm long	nr
(i)	Hardwood sleeper 250 x 2900 mm long	nr

Unit Rate (£)

(j)	Hardwood sleeper 250 x 3050 mm long	nr
(k)	Hardwood sleeper 250 x 3200 mm long	nr
9.5.5.2	**Supply only the following fittings**	
(a)	Chairs (including ferrules and chair screws)	nr
(b)	Baseplates	nr
(c)	Rail Pads	nr
(d)	Pandrol Clips	nr
(e)	GRN Rail Insulators	nr
(f)	Expansion Switch (excluding sleeper)	nr
(g)	Insulating Pots 317P21 (including packing clip)	nr
(h)	Insulating Pots 317P20 (including packing clip)	nr
(i)	Welded Joints	nr
(j)	Conductor rail safety block 297P581	nr
(k)	Conductor rail safety pad RBC 90522	nr
(l)	Conductor rail safety anchors single 253P1	set
(m)	Conductor rail safety anchors double 253P14	set
(n)	113A FB G - Clamp Fishplates	set
(o)	113A FB Insulated Joints (complete) 4 hole	kit

	Unit	**Rate (£)**

(p)	FB (new)/BH (worn 1.6mm) Junction Fishplates 279P197	set
(q)	113A FB Fishbolts 910P103	nr
(r)	95R BH Fishbolts 63/813	nr
9.5.5.3	**Supply only the following switches and crossings**	
(a)	Turnout Type AV7	nr
(b)	Turnout Type BV8	nr
(c)	Turnout Type CV9¼	nr
(d)	Turnout Type DV103/4	nr
9.5.5.4	**Supply only the following sundries**	
(a)	Buffer Stops	nr
(b)	Lubricators	nr
(c)	Switch Heaters	nr
(d)	Switch Lever	nr
(e)	Conductor Rail Guard Board	m
9.5.5.5	**Supply only the following in Protection Planking**	
(a)	Single bracket	
	(i) negative rail	m
	(ii) positive rail	m

	Unit	**Rate (£)**

(b)	Double bracket		
	(i)	negative rail	m
	(ii)	positive rail	m

9.5.5.6 **Drainage and Formation Works (Continued)**

(a)	Supply and lay 250mm deep crushed granite ballast laid in two operations	m^3
(b)	Ditto 220mm deep	m^3
(c)	Ditto 150mm deep	m^2
(d)	Ditto 50mm deep	m^2
(e)	Identify saving for skimming and laying 50mm deep ballast in lieu of 300mm deep ballast	m^2
(f)	Ditto in lieu of 250mm deep ballast	m^2
(g)	Excavate, trench not exceeding 1m deep below formation level. Lay 300mm diameter pipe and backfill in accordance with the Specification	
(h)	Ditto 250mm dia. pipe	m
(j)	Ditto 150mm dia. pipe	m
(k)	Relocate catchpit complete including demolition of existing and construction of new catchpit depth not exceeding 1m	nr
(l)	Supply and by lean mix concrete in accordance	m^3

Unit Rate (£)

	with the Specification in backfilling to soft spots	
(m)	Take down and later re-erect chain link fencing	m
9.5.5.7	**Laying/Fixing the following Sundries**	
(a)	Buffer Stops	nr
(b)	Lubricator	nr
(c)	Switch Heater	nr
(d)	Switch Lever	nr
(e)	Conductor Rail Guard Board	m
9.5.5.8	**Associated Track Works**	
(a)	Lift, pack and slew existing track comprising flat bottom rail and timber sleepers distance not exceeding 1.5m including digging out and boxing up ballast	m
(b)	Destressing LWR	nr
(c)	Supply complete adjustment switch	nr
(d)	Relocate LWR adjustment switch	nr
(e)	Laying new adjustment switch	nr
9.5.5.9	**Drainage and Formation Works**	
(a)	Excavate ballast and remove from site	m^3

Unit Rate (£)

(b)	Excavate formation and remove from site	m^3
(c)	Excavate material in soft spots and remove from site	m^3
(d)	Supply and lay 300mm deep crushed granite ballast laid in two operations	m^3
(e)	Supply and lay sand blinding	m^2
(f)	Supply and lay geotextile membrane	m^2

9.5.5.10 **Laying only the following in:-**

Flat bottom rails, mass 65.4 kg/m. BS rail section nr 113A

(a)	Plain track complete	m
(b)	Extra over for forming curve in plain track radius not exceeding 300m	m
(c)	Extra over for forming curve in plain track radius not exceeding 300m	m
(d)	Extra over plain track for laying Turnout type AV7	nr
(e)	Turnout Type BV9¼	nr
(f)	Turnout Type CV103/4	nr
(g)	Turnout Type DV15	nr
(h)	Scissor Crossing	nr

Unit Rate (£)

(i)	Conductor Rail	nr
(j)	Length Ends	nr
(k)	Side Ramps	nr
(l)	Spot Re-sleepering	nr
	(i) Weld @ 2 per 8 hour shift	nr
	(ii) Weld @ 4 per 8 hour shift	nr
	(iii) Weld @ 6 per 8 hour shift	nr

9.5.6 Power Works

The following items are to be used for pricing variations. Any item left unpriced shall be deemed to be included elsewhere.

(a)	Supply and install a 9 metre galvanised column complete with two 250 wattson fittings per column including all accessories (cut out, holding down bolts, backboard, etc.) interconnecting cables from cut-out to lighting fittings.	nr.
(b)	Provide and lay interlocking cable tiles and warning tape etc.	nr.
(c)	Supply and install section switches, in accordance with requirements in Schedule 6 Part I, complete with all civil works, bonding, testing and commissioning.	nr.
(d)	Supply and install	

Unit Rate (£)

	(i)	highbay luminaires 250 watt son,	nr.
	(ii)	fluorescent 5ft single batten	nr.
(e)		Supply additional bonding cost to complete the bonding to the conductor rail every 15 metres. The complete installation is to include all accessories.	nr.
(f)		Supply and install complete control cubicles for point heaters	nr.
(g)		Supply and install point heater local transformer unit to include terminations.	nr.
(h)		Supply and install point heaters complete with all heating strips, glue, straps and other accessories	nr.
(i)		Supply and install 935mm^2 single core cable complete with all connections, lugs and other accessories	nr.
(j)		Supply and install 110 volt socket outlet, complete with cabling and wayleaves	nr.
(k)		Disconnect and remove existing DC section switches complete with housing	nr.
(l)		Supply and install additional earthing and bonding	nr.
(m)		Disconnect and remove existing materials no longer required and remove from site as directed	nr

Unit Rate (£)

9.5.6.1 **Conduit, Trunking and Troughing**

Installation of conduit, trunking & troughing shall include the fixing of all adaptable boxes, accessories & fixings

(a)	20mm steel conduit surface run	m
(b)	25mm steel conduit surface run	m
(c)	32mm steel conduit surface run	m
(d)	20mm steel conduit chased or cast including marking out but excluding chasing or making good	m
(e)	25mm steel conduit chased or cast including marking out but excluding chasing or making good	m
(f)	32mm steel conduit chased or cast including marking out but excluding chasing or making good	m
(g)	20, 25, or 32mm flexible conduit	m
(h)	20, 25 or 32m flexible conduit adaptor	Item
(i)	20 or 25mm bonding nipple including locknut	Item
(j)	50 x 50mm steel trunking surface run	m
(k)	75 x 75mm steel trunking surface run	m
(l)	100 x 50 x & 100 x 75mm steel trunking surface run	m
(m)	100 x 100mm steel trunking surface run	m

Unit Rate (£)

(n)	150 x 100 steel trunking surface run	m
(o)	150 x 150mm steel trunking surface run	m
(p)	Install partition in trunking	m
(q)	Cable troughing	m
(r)	Install fire barrier in trunking	Item

9.5.6.2.1 **Cables**

Installation of cables of the following description

(a)	1.5/2.5mm^2	2 core PVC/SWA/OVC or LS/SWA cable run in existing “Doulton” cleats including removal & replacement of cleat section	m
(b)	4/6mm^2	Ditto	m
(c)	10/16mm^2	Ditto	m
(d)	25/35mm^2	Ditto	m
(e)	50mm^2	Ditto	m
(f)	70mm^2	Ditto	m
(g)	1.5/2.5mm^2	2 core PVC/SWA/PVC or LS/SWA cable run in cleats/clips including fixing of cleats/clips 1/2	m
(h)	4/6mm^2	Ditto	m

Unit Rate (£)

(i)	10/16mm^2	Ditto	m
(j)	25/35mm^2	Ditto	m
(k)	50mm^2	Ditto	m
(l)	70mm^2	Ditto	m
(m)	1.5/2.5mm^2	2 core PVC/SWA/PVC or LS/SWA cable run in existing open brackets or trays including cable ties	m
(n)	4/6mm^2	Ditto	m
(o)	10/16mm^2	Ditto	m
(p)	25/35mm^2	Ditto	m
(q)	50mm^2	Ditto	m
(r)	70mm^2	Ditto	m
(s)	1.5/2.5mm^2	2 core XLPE/SWA/LSF or LS/SW cable run in ducts including rodding of ducts	m
(t)	4/6mm^2	Ditto	m
(u)	10/16	Ditto	m
(v)	25/35mm^2	Ditto	m
(w)	50mm^2	Ditto	m
(x)	70mm^2	Ditto	m

Unit Rate (£)

(y)	1.5/2.5mm^2	2 core XLPE/SWA/LSF or LS/SWA cable run in existing "Doulton" cleats including removal & replacement of cleat section	m
(z)	4/6mm^2	Ditto	m
(aa)	10/16mm^2	Ditto	m
(bb)	25/35mm^2	Ditto	m
(cc)	50mm^2	Ditto	m
(dd)	70mm^2	Ditto	m
(ee)	1.5/2.5mm^2	2 core XLPE/SWA/LSF or LS/SWA cable run in cleats/clips including fixing of cleats/clips 1/2	m
(ff)	4/6mm^2	Ditto	m
(gg)	10/16mm^2	Ditto	m
(hh)	25/35mm^2	Ditto	m
(ii)	50mm^2	Ditto	m
(jj)	70mm^2	Ditto	m
(kk)	1.5/2.5mm^2	2 core XLPE/SWA/LSF or LS/SWA cable run in existing open brackets or trays including cable ties	m

Unit Rate (£)

(ll)	4/6mm^2	Ditto	m
(mm)	10/16mm^2	Ditto	m
(nn)	25/35mm^2	Ditto	m
(oo)	50mm^2	Ditto	m
(pp)	70mm^2	Ditto	m
(qq)	1.5/2.5mm^2	4/3 core XLPE/SWA/LSF or LS/SWA cable run in existing "Doulton" cleats including removal & replacement of cleat sections	m
(rr)	4/6mm^2	Ditto	m
(ss)	10/16mm^2	Ditto	m
(tt)	25/35mm^2	Ditto	m
(uu)	50mm^2	Ditto	m
(vv)	70mm^2	Ditto	m
(ww)	1.5/2.5mm^2	4/3 core XLPE/SWA/LSF or LS/SWA cable run in cleats/clips including fixing of cleats/clips	m
(xx)	4/6mm^2	Ditto	m
(yy)	10/16mm^2	Ditto	m
(zz)	25/35mm^2	Ditto	m

Unit Rate (£)

(aaa)	50mm^2	Ditto	m
(bbb)	70mm^2	Ditto	m
(ccc)	1.5/2.5mm^2	4/3 core XLPE/SWA/LSF or LS/SWA cable run in ducts including rodding of ducts	m
(ddd)	4/6mm^2	Ditto	m
(eee)	10/16mm^2	Ditto	m
(fff)	25/35mm^2	Ditto	m
(ggg)	50mm^2	Ditto	m
(hhh)	70mm^2	Ditto	m
(iii)	4/6mm^2	4/3 core XLPE/SWA/LSF or LS/SWA cable run in existing open brackets or trays including cable ties	m
(jjj)	4/6mm^2	Ditto	m
(kkk)	10/16mm^2	Ditto	m
(lll)	25/35mm^2	Ditto	m
(mmm)	50mm^2	Ditto	m
(nnn)	70mm^2	Ditto	m
(ooo)	1.5mm^2	2.3 or 4 core MICC clipped direct	m

Unit Rate (£)

		to wall or ceiling		
(ppp)	2.5mm^2	Ditto		m
(qqq)	4mm^2	Ditto		m
(rrr)	1.5/2.5mm^2	2 or 3 core XLPE/LSF with CPC cable clipped direct to wall or ceiling		m
(sss)	4mm^2	Ditto		m
(ttt)	4/6mm^2	Layout 3 or 5 core "ENFIELD" grid suspension cable		m
(uuu)	10/16mm^2	Ditto		m
(vvv)		30 metres pre manufactured lighting festoon with lamps and plugs		m
(www)		50 metres	Ditto	m
(xxx)		100 metres	Ditto	m
(yyy)		30 metres pre manufactured power festoon with lamps and plugs		m
(zzz)		50 metres	Ditto	m
(aaaa)		100 metres	Ditto	m
(bbbb)	1.5/2.5mm	4/3 PVS/SWA/PVC or LS/SWA cable run in ducts including rodding of ducts		m

Unit Rate (£)

(cccc)	4/6mm² 10/16mm²	Ditto	m
(dddd)	25/35mm²	Ditto	m
(eeee)	50mm²	Ditto	m
(ffff)	70mm²	Ditto	m
(gggg)	1.5/2.5mm²	2 core PVC/SWA/PVC or LS/SWA cable run inducts including rodding of ducts	m
(hhhh)	4/6mm²	Ditto	m
(iiii)	10/16mm²	Ditto	m
(jjjj)	25/35mm²	Ditto	m
(kkkk)	50mm²	Ditto	m
(llll)	70mm²	Ditto	m
(mmmm)	1.5/2.5mm²	4/3 core PVC/SWA/PVC or LS/SWA cable run in existing "Doulton" cleats including removal and replacement of cleat sections	m
(nnnn)	4/6mm²	Ditto	m
(oooo)	10/16mm²	Ditto	m
(pppp)	25/35mm²	Ditto	m

Unit Rate (£)

(qqqq)	50mm²	Ditto	m
(rrrr)	70mm²	Ditto	m
(ssss)	1.5/2.5mm²	4/3 core PVC/SWA/PVC or LS/SWA cable run in cleats/clips including fixing of cleats/clips	m
(tttt)	4/6mm²	Ditto	m
(uuuu)	10/16mm²	Ditto	m
(vvvv)	25/35mm²	Ditto	m
(wwww)	50mm²	Ditto	m
(xxxx)	70mm²	Ditto	m
(yyyy)	1.5/2.5mm²	4/3 core PVC/SWA/PVC or LS/SWA cable run in ducts including rodding of ducts	m
(zzzz)	4/6mm²	Ditto	m
(aaaaa)	10/16mm²	Ditto	m
(bbbbb)	25/35mm²	Ditto	m
(ccccc)	50mm²	Ditto	m
(ddddd)	70mm²	Ditto	m
(eeeee)	1.5/2.5mm²	4/3 core PVC/SWA PVC or LS/SWA cable run in existing open	m

Unit Rate (£)

		brackets or trays including cables ties	
(fffff)	4/6mm²	Ditto	m
(ggggg)	10/16mm²	Ditto	m
(hhhhh)	25/35mm²	Ditto	m
(iiiii)	50mm²	Ditto	m
(jjjjj)	70mm²	Ditto	m
(kkkkk)	1.5/2.5mm²	2 or 3 core PVC/PVC wirth CPC cable clipped direct to wall or ceiling	m
(lllll)	4mm²	Ditto	m

9.5.6.2.2 **Jointing and Termination of Cables**

(a)		Fix grid suspension box complete with anchoring device, grommets, nuts washers bridle & compound to cable & mount on anchorage point		Item
(b)		Ditto	151/A (25mm)	Item
(c)		Ditto	151/B (32mm)	Item
(d)		Ditto	151/C (40mm)	Item
(e)		Ditto	151/C2 (50mm)	Item
(f)		Install BICC ‘Bicast’ joint MPJ2,		Item

Unit Rate (£)

		MPJ3, MPJ4, & MPJ5 including bonding strap	
(g)	1.5/2.5mm^2	Jointing, terminating and/or connecting conductors where not included in other scheduled items	Item
(h)	4/6mm^2	Ditto	Item
(i)	10/16mm^2	Ditto	Item
(j)	25/35mm^2	Ditto	Item
(k)	50	Ditto	Item
(l)	70mm^2	Ditto	Item
(m)	95mm^2	Ditto	Item
(n)	150mm^2	Ditto	Item
(o)	185mm^2	Ditto	Item
(p)	240mm^2	Ditto	Item
(q)	300mm^2	Ditto	Item
(r)	500mm^2	Ditto	Item
(s)	850mm^2	Ditto	Item
(t)	1.5mm^2	Termination of 2,3 or 4 core MICC complete with glands, seals, locknuts & shrouds	Item

Unit Rate (£)

(u)	2.5mm^2	Ditto	Item
(v)	4mm^2	Ditto	Item
(w)	1.5/16mm^2	Crimp cable lug to cable	Item
(x)	25/70mm^2	Ditto	Item
(y)	95mm^2	Ditto	Item
(z)		BICC ‘Leprack’ hook cleat (01-12) or BICC ‘Leprack’ claw cleat (01-08)	Item
(aa)		BICC ‘Leprack’ two bolt cleat (09-12) (BF70217) or (BF70068) (01-02) or (F70068) (02-06)	Item
(bb)		75, 100 or 150mm heavy duty return edge cable tray	Item
(cc)		225 or 300mm Ditto	Item
(dd)		425 or 600mm Ditto	Item

9.5.6.3 Distribution Boards, MCB's and Busbar Chambers

9.5.6.3.1 Fuseboards

Installation of distribution boards, MCB’s and busbar chambers shall include connections, fixings and/or links and labels (Including “spare” labels on unused ways)

(a)	4 way 20 amp SP&N or DP fuseboard		Item
(b)	6 way	Ditto	Item

	Unit	**Rate (£)**

(c)	8 way	Ditto	Item
(d)	10 way	Ditto	Item
(e)	12 way	Ditto	Item
(f)	4 way 20 amp TP&N fuseboard		Item
(g)	6 way	Ditto	Item
(h)	8 way	Ditto	Item
(i)	10 way	Ditto	Item
(j)	12 way	Ditto	Item

9.5.6.3.2 **Switchgear**

Installation of switchgear shall include connections, fixings, labels, fuses and/or links.

(a)	30 amp DP combination fuse switch 500 volt English Electric HP type		Item
(b)	30 amp TR&N	Ditto	Item
(c)	60/100 amp DP	Ditto	Item
(d)	60/100 amp TR&N	Ditto	Item
(e)	200 amp DP	Ditto	Item
(f)	200 amp TR&N	Ditto	Item
(g)	300 amp TR&N	Ditto	Item
(h)	400 amp 4 pole combination fuse switch complete		Item

Unit Rate (£)

	with top and bottom cable housing		
(i)	Standard 100, 200, 300 or 400 section L15709/10/11/12		Item
(j)	Install section interconnecting links		Set
(k)	200 amp DP fuseswitch Reyrolle		Item
(l)	400 amp	Ditto	Item
(m)	Standard 6100, 6200 or 6300 sections		Item
(n)	30 or 60 amp 4 pole changeover switch		Item
(o)	30 or 60 amp 4 pole changeover contractor in enclosure		Item
(p)	20 amp DP	Ditto	Item
(q)	40 or 60 amp on-load waterproof isolator		Item
(r)	100 amp	Ditto	Item

9.5.6.3.3 **Busbar Chambers**

Installation of distribution boards, MCB's and busbar chamber shall include connections, fixings fuses and/or links and labels (including "spare" labels on unused ways).

(a)	550mm 400 amp pole busbar chamber mounted on steel frame		Item
(b)	900mm	Ditto	Item

Unit Rate (£)

(c)	1350mm	Ditto	Item
(d)	1800mm	Ditto	Item
(e)	Install “Temby” earth clamp including preparing metal work		Item
(f)	Earth terminal bar in adaptable box including adaptable box		Item
(g)	Copper earth rod section including driving cap, tip jointing stud & terminal clamp		Item
(h)	Fuse in 20 or 32 amp carrier		Item
(i)	Fuse in 32 or 100 amp carrier		Item
(j)	20, 32 or 63 amp fuse base mounted on slate panel		Item
(k)	Ditto in distribution board		Item
(l)	100 amp fuse base mounted on slate		Item
(m)	200 amp	Ditto	Item
(n)	550mm long 100A 4 pole busbar chamber mounted on steel frame		Item
(o)	900mm long 100A 4 pole busbar chamber mounted on steel frame		Item
(p)	1350mm long 100A 4 pole busbar chamber mounted on steel frame		Item

Unit Rate (£)

(q)	1800mm long 100A 4 pole busbar chamber mounted on steel frame	Item
(r)	550mm long 200A 4 pole busbar chamber mounted on steel frame	Item
(s)	900mm long 200A 4 pole busbar chamber mounted on steel frame	Item
(t)	1350mm long 200A 4 pole busbar chamber mounted on steel frame	Item
(u)	1800mm long 200A 4 pole busbar chamber mounted on steel frame	Item
(v)	550mm 400 amp pole busbar chamber mounted on steel frame	Item
(w)	900mm 400 amp pole busbar chamber mounted on steel frame	Item
(x)	1350mm 400 amp pole busbar chamber mounted on steel frame	Item
(y)	1800mm 400 amp pole busbar chamber mounted on steel frame	Item

9.5.6.3.4 **Distribution Boards and MCB's**

(a)	6 Way SP&N distribution board with/without main switch	Item
(b)	9 Way SP&N distribution board with/without main	Item

Unit Rate (£)

	switch	
(c)	12 Way SP&N distribution board with/without main switch	Item
(d)	4 Way TP&N MCB distribution board type B with/without main switch	Item
(e)	6 Way TP&N MCB distribution board type B with/without main switch	Item
(f)	8 Way TP&N MCB distribution board type B with/without main switch	Item
(g)	10 Way TP&N MCB distribution board type B with/ without main switch	Item
(h)	3 or 4 way metal enclosure for MCBs	Item
(i)	5 to 6 amp SP SP&N MCB mounted in distribution board	Item
(j)	5 to 60A SP&N or DP MCB mounted in distribution board	Item
(k)	5 to 60A TP MCB mounted in distribution board	Item
(l)	5 to 60A SP MCB mounted in 3 or 4 way metal enclosure	Item
(m)	5 to 60A SP&N or DP MCB mounted in 3 or 4 way metal enclosure	Item

	Unit	**Rate (£)**

(n)	5 to 60A TP mounted in 3 or 4 way metal enclosure	Item
(o)	5 to 60A TP&N MCB mounted in 3 or 4 way metal enclosure	Item
(p)	Install "Temby" earth clamp including preparing metal work	Item
(q)	Earth terminal bar in adaptable box including adaptable box	Item
(r)	Copper earth rod section including driving cap, tip jointing stud and terminal clamp	Item
(s)	Fuse in 20 or 32 amp carrier	Item
(t)	Fuse in 32 or 100 amp carrier	Item
(u)	20, 32 or 63 amp fuse base mounted on slate panel	Item
(v)	20, 32 or 63 amp fuse base in distribution board	Item
(w)	100 amp fuse base mounted on slate panel	Item
(x)	200 amp fuse base mounted on slate	Item

9.5.6.3.5 **Transformers**

Installation of Transformers shall include connections, fixings and labels.

(a)	Earth proving unit (including adjustments)	Item
(b)	415/220V delta, 3 x 2Kva transformer in enclosure mounted onto racket	Item

Unit Rate (£)

(c)	415/55V delta, 3 x 2Kva transformer in enclosure mounted onto racket	Item
(d)	240/110/55v delta, 3 x 2Kva transformer in enclosure mounted onto racket	Item
(e)	415/90V, 3 x 2Kva delta, 3 x 2Kva transformer in enclosure mounted onto racket	Item
(f)	415/220V Delta, 3 x 759 VA delta, 3 x 2Kva transformer in enclosure mounted onto racket	Item

9.5.6.3.6 **Low Voltage Sockets**

Installation of low voltage sockets shall include connections, fixings and labels.

(a)	240/110/55V 6Kva transformer in enclosure	Item
(b)	2Kva transformer in enclosure	Item
(c)	15 or 32 amp 110/55V socket with box	Item
(d)	15 or 32 amp 110/55V socket on existing box	Item
(e)	15 or 32 amp 110/55V plug	Item

Unit Rate (£)

9.5.6.4 Fixings

Where fixings are not included in the rates for other items the following shall apply:

(a)	100 --150mm rag bolts in brickwork up to 25mm dia	Item
(b)	100 --150mm rag bolts in concrete	Item
(c)	"Kemfix" in masonry	Item
(d)	No: 10 plastic "Rawplug"	Item
(e)	Drill & tap M or MB into case iron or steel and insert stud with nuts and washers	Item
(f)	20mm or 25mm steel drop rods	Item
(g)	P1000, P2000, P4000, P2001 or P4001 Unistrut channel including brackets, clamps, nuts etc.	m
(h)	50 x 50 x 6mm steel angle iron. Cut de-bured & drilled as required	m
(i)	50 x 6mm Steel strap. Cut de-bured & drilled as required	m
(j)	50 x 6mm Steel strap Ditto	m

Unit Rate (£)

9.6 DAYWORKS

9.6.1 General

9.6.1.1 The rates and percentage adjustments inserted herein by the Contractor are for use where the Company has agreed that a Variation should be carried out on a daywork basis pursuant to paragraph 8.5.

9.6.1.2 Where reimbursement in accordance with this paragraph 9.6 is based on invoiced costs, such invoices shall be provided as evidence of purchase and/or cost before any payment may be made.

9.6.2 Labour

9.6.2.1 The rates for labour are to include without limitation:

(a) wages, actual bonus paid, daily travelling allowances (fare and/or time), tool allowance and all prescribed payments including those in respect of time lost due to inclement weather paid to workmen at plain time rates and/or overtime rates;

(b) management, supervision, site preliminaries, overhead, travelling time and head office charges;

(c) the cost of free transport provided by the Contractor for workmen to, from and about the Site;

(d) national insurances and surcharge;

(e) normal third party and contractor's liability (including employer's liability) insurances;

(f) annual and public holidays with pay and benefits scheme;

(g) non-contributory sick pay scheme;

(h) industrial training levy;

(i) redundancy payments contribution;

(j) contracts of employment and all statutory charges;

(k) small tools - such as picks, shovels, barrows, trowels, hand saws, buckets, trestles, hammers, chisels, hand-held power tools, and all items of a like nature;

(l) consumables - such as cleaning materials, welding or cutting gases, and all items of a like nature;

(m) protective clothing and equipment; and

(n) welfare facilities provided by the Contractor.

9.6.2.2 The daywork rates for labour stated in the table set out in paragraph 9.6.2.4 shall apply to all normal working in Traffic Hours. For work authorised by the Company to be carried out in Engineering Hours, the daywork rates for labour shall apply as stated in such table as amended by the percentage adjustment in paragraph (a) at the end of such table.

9.6.2.3 The Company may, in writing, require any labour to stand down for whatever reason as it may instruct and in such event the Company will reimburse at the daywork rates for labour as stated in the table set out in paragraph 9.6.2.4 as amended by the percentage adjustment for non-productive time stated in paragraph (b) at the end of such table.

9.6.2.4 The Contractor is to provide rates for the items listed in the following table pursuant to paragraph 1 of Section 2 of Part E of Schedule 10.

DESCRIPTION	UNIT	RATE

		£
Site Engineer	hr	
Surveyor	hr	
Quantity Surveyor	hr	
Design Engineer	hr	
Typist	hr	
Draughtsman	hr	
Foreman	hr	
Steelfixer	hr	
Concreter	hr	
Carpenter	hr	
Bricklayer	hr	
Welder	hr	
Fitter	hr	
Approved Electrician	hr	
Electrician	hr	
Painter	hr	
Roofer	hr	
Plumber	hr	
Plasterer	hr	
Ganger	hr	
Equipment Operator	hr	
Labourer	hr	
Commissioning Engineer - (Mechanical, Electrical or Instrument Engineer)	hr	
Commissioning Technician - (Mechanical, Electrical or Instrument Engineer)	hr	

Percentage Adjustments to Normal Rates of Labour	
(a)	**Rates for Engineering Hours** **ADD** _____ %
(b)	**Non-Productive Time** ***ADD/DEDUCT** _____ %

9.6.3 MATERIALS

9.6.3.1 The net invoiced cost of materials for use in connection with dayworks delivered to the Site shall be adjusted by the percentage addition stated in paragraph 9.6.3.2 which shall include, without limitation, for all costs incurred in connection

with ordering, transporting, delivering, unloading, storing, distributing, losses, wastage and head office charges.

9.6.3.2 Percentage addition to the invoiced cost of materials for use in connection with dayworks:

ADD _____ %

9.6.4. CONTRACTOR'S PLANT

9.6.4.1 The Contractor shall state the rate to be charged for any item of plant required for any Variation.

9.6.4.2 These rates shall apply to plant owned or hired by the Contractor which is already on the Site and shall be exclusive of driver or operator and attendants but inclusive of fuel, consumable stores, repairs, general servicing, maintenance, insurance of plant, distribution of fuel, head office charges and profit.

9.6.4.3 Minimum hire charge will be for the period quoted.

9.6.4.4 Plant hired exclusively for use in connection with dayworks shall be reimbursed at the full amount of the amount invoiced to the Contractor including fuel, oil and grease, insurance, transport and other like charges (without deduction of any cash discounts not exceeding 2.5%) and as modified by the percentage addition specified in paragraph 9.6.4.5 to which should be added the cost of consumables where supplied by the Contractor (but not by the equipment hirer). The cost of drivers or operatives shall be reimbursed in accordance with the daywork rates for labour calculated in accordance with paragraph 9.6.2.

Schedule of Contractor's Equipment			
Item of Plant	***Description**	***Unit**	***£/hour Hire Rate**
Mobile (public road) crane Mobile (public road) crane	50t 20t	Hour	

Mobile (public road) crane	15t		
All terrain crane	20t		
All terrain crane	10t		
All terrain crane	5t		
Crawler crane			
Crawler crane			
Crawler crane			
Bulldozer			
Bulldozer			
Bulldozer			
Hydraulic Excavator			
Hydraulic Excavator			
Hydraulic Excavator			
Concrete pump			
JCB (including Fuel & Operator)			
Welding Set	400 AMP		
Welding Set			
Compressor (inclusive of hoses and/or breakers)			
Compressor (inclusive of hoses and/or breakers)			
Compressor (inclusive of hoses and/or breakers)	250 CFM		
Lorry	40"-0" SEMI		
Lorry			
Lorry with "Hiab"			
Dump Truck			
Dump Truck			
Dump Truck			
Portable Generator	15 KVA		
Portable Generator			
Portable Generator			
Pump (including suction & delivery hoses)	Test Pump		
Pump (including suction & delivery hoses)			
Pump (including suction & delivery hoses)			
Scaffolding (per 1m run per 2m lift)			
"Cherry Picker" access equipment			
Paint spray equipment (set)			
Other (Contractor to state)			

* Contractor to complete description, unit and hire rate. Description should be limited to tonnes, capacity, safe working load etc. as appropriate.

9.6.4.5 Where plant is not on the Site or cannot be used for a Variation as it is required for use in other Enabling Works and the Contractor has to hire additional

plant from a plant hirer as a result thereof, payment for such additional hired plant shall be the amount specified in the plant hirer's invoice less Value Added Tax (but without deduction of any cash discount not exceeding 2½ per cent.) plus the Contractor's percentage addition below for all costs incurred in connection with ordering, transporting, delivering, unloading, storing and head office charges: **ADD** _____ %. Fuels and consumables supplied by the Contractor in respect of such hired plant for use on authorised daywork shall be calculated in accordance with paragraph 9.6.3.

10. SUSPENSION

The Contractor shall on the written order of the Project Manager suspend work on this Contract or any part thereof for such time or times and in such manner as the Project Manager may consider necessary and shall during such suspension properly protect and secure any work so far as is necessary in the opinion of the Project Manager. Such written order shall be by way of a Notice of Required Variation. The Contractor shall not be entitled to be paid the extra cost (if any) incurred in giving effect to the Project Manager's instructions under this paragraph to the extent that such suspension is:

(a) otherwise provided for in this Contract; or

(b) necessary by reason of some default on the part of the Contractor; or

(c) necessary for the proper carrying out of the Contractor's obligations under this Contract in as much as such necessity does not arise from any act or default of the Company.