OPEN TENDER

RSSB INVITATION TO TENDER FOR THE PROVISION OF: RSSB2757 - T1161 Improvements to pantograph collector strips maintenance and to Automatic Dropping Device

Deadline: Friday 18th January 2019

ITT Reference: RSSB2757 - T1161 Improvements to pantograph collector strips maintenance and to Automatic Dropping Device

# TENDER DOCUMENTS

1.1 Tenders shall be submitted in accordance with the following instructions. It is important that all the information requested is provided in the format and order specified. If the Tenderer does not provide all of the information RSSB has requested within the tender pack, RSSB may reject the tender as non-compliant.

1.2 Tenderers must obtain for themselves, at their own responsibility and expense, all information necessary for the preparation of their tender. Tenderers are solely responsible for any costs and expenses in connection with the preparation and submission of their Tender, and all other stages of the selection and evaluation process. Under no circumstances will RSSB, or its advisors, be liable for any costs or expenses Tenderers, their sub-contractors, suppliers or advisors incur in this process, including if this tendering process is terminated or amended by RSSB.

1.3 Tenderers are solely responsible for obtaining the information that they consider is necessary in order to prepare the content of their tender and to undertake any investigations they consider necessary in order to verify any information RSSB provides during the procurement process.

1.4 All pages of the tender submission must be sequentially numbered (including any forms to be completed and returned).

1.5 All specifications, plans, drawings, samples and patterns and anything else that RSSB issues in connection with this ITT, remains the property of RSSB and are to be used solely for the purpose of tendering.

1.6 At any time prior to the deadline for receipt of questions, RSSB may modify the tender documents by amendments in writing.

1.7 RSSB (at its sole discretion) may extend the deadline for receipt of Tenders.

RSSB reserves the right to modify or to discontinue the whole of, or any part of, this tendering process at any time and accepts no obligation whatsoever to award a contract.

# GENERAL, LEGAL & COMPLIANCE

2.1 RSSB will check each tender for completeness and compliance with the tender instructions. RSSB reserves the right to reject any tenders it considers substantially incomplete, or non-compliant (each tender will be assessed on its own merit, according to the level/importance of omitted or non-compliant content).

2.2The Tenderer will be excluded should any of the grounds for mandatory rejection or discretionary rejection be triggered. Mandatory requirements can be viewed within the Public Contracts Regulations 2015.

2.3 Tenderers are required to confirm in their tender response, they are able to meet all mandatory and discretionary requirements.

2.4 The Tenderer will be excluded should it be assessed that it has a high risk of:

* + Insolvency over the lifetime of the contract; e.g. the Tenderer may be excluded if its current assets to current liabilities ratio is less than 1;
  + Insufficient financial capacity to deliver the services effectively; or
  + Over-dependence on RSSB (e.g. the Tenderer may be excluded if its turnover is less than £ [no more than2x the contract value]

# 3.0 TENDER INSTRUCTIONS

3.1 “RSSB” means the contracting authority, seeking to invite suppliers to participate in the procurement process.

“You” or “Supplier” means the legal entity completing these questions, seeking to be invited to the next step of the procurement process Invitation to Tender (ITT)

3.2 Please ensure all questions are completed in full and in the format requested. Failure to do so may result in your submission being disqualified. If the question does not apply you need to clearly state N/A.

3.3 If it is necessary for you to provide additional information this should be provided as an appendix and clearly referenced as part of your declaration.

3.4 **RSSB REPRESENTATIVE**

Your main point of contact is: [shareditt@rssb.co.uk](mailto:shareditt@rssb.co.uk)

**RSSB OVERVIEW**

If you wish to find out more about RSSB, please visit our website at [www.rssb.co.uk](http://www.rssb.co.uk)

**Timetable**

The timetable for this procurement follows. This is intended as a guide and whilst RSSB does not intend to depart from the timetable, it reserves the right to do so at any stage.

The expected milestones are set out below:

|  |  |
| --- | --- |
|  | **Start Date** |
| I.T.T issued on Contracts Finder | 7 Dec 2018 |
| Supplier clarification questions deadline | 11 Jan 2019 |
| **Deadline for Submitting tenders** | **18 Jan 2019** |
| Post Tender Evaluation and Clarification | w/c 21 Jan 2019 |
| Estimated notification of award decision | w/c 28 Jan 2019 |
| Target contract commencement date | w/c 4 Feb 2019 |

Note: RSSB reserves the right to amend these dates as business requirements demand and will communicate any changes to tenderers.

3.5 **QUESTIONS**

Should you have any questions relating to the project, please email these before the deadlines detailed in the project timeline above to ensure that these questions can be effectively addressed? To ensure equal and fair treatment to all potential suppliers, RSSB will circulate all questions and responses anonymously.

Questions should be emailed to: [shareditt@rssb.co.uk](mailto:shareditt@rssb.co.uk)

# 4.0 Evaluation Information

4.1 In the interests of an open, fair and transparent assessment, this document sets out how RSSB intends to evaluate tender responses. It outlines the evaluation criteria and respective weightings, as well as the evaluation methodology to be applied.

4.2 **Verification of Information Provided**

Whilst reserving the right to request information at any time throughout the procurement process. RSSB may enable the Supplier to self- certify that there are no mandatory/ discretionary grounds for excluding their organisation. When requesting evidence that the supplier can meet the specified questions relating to Technical and Professional Ability RSSB may only obtain such evidence after the final tender evaluation decision and only from the winning Supplier only.

4.3 **Please self-certify whether you already have, or can commit to obtain, prior to the commencement of the contract, the levels of insurance cover indicated below:**

* Employer’s (Compulsory) Liability Insurance = £2M
* Public Liability Insurance = £1M
* Professional Indemnity Insurance = £1M

4.4 **Sub- contracting Arrangements**

Where the Supplier proposes to use one or more sub- contractors to deliver some or all of the contract requirements, a separate Appendix should be used to provide details of the proposed delivery model that includes members of the supply chain and percentage of work being delivered by each sub -contractor and the key deliverables that each sub- contractor will be responsible for.

RSSB recognises that sub- contracting arrangements may be subject to change and not finalised until a later date. However, Suppliers should be aware that where information provided to RSSB indicates that sub- contractors are to play a significant role in delivering the key requirements and any changes to those sub- contracting arrangements significantly affect the ability of the supplier to deliver key requirements the Supplier should notify RSSB immediately of any changes in the proposed supplier sub-contractor arrangements. RSSB reserves the right to deselect the Supplier prior to any award of contract based on an assessment of the updated information.

4.5 **Consortia Arrangement**

If the Supplier completing this tender submission is doing so as part of a proposed consortium the following information must be provided:

* Names of all consortium members;
* The lead member of the consortium who will be contractually responsible for delivery of the contract (if a separate legal entity is not being created); and
* If the consortium is proposing to form a legal entity, full details of the proposal should be submitted as an Appendix with this Tender.
* RSSB may require the consortium to assume a specific legal form if awarded the contract. If it is deemed that a legal incorporation is necessary for the satisfactory performance of the contract.
* All members of the consortium will be required to provide the information required in all sections of the Tender as part of a single composite response to RSSB i.e. each member of the consortium is required to contribute to completing the response document.

4.6 **Confidentiality**

RSSB reserves the right to contact the named customer contact and the nominated customer does not owe RSSB any duty of care or have any legal liability, except for any deceitful or maliciously false statements of fact.

RSSB confirms that it will keep confidential and will not disclose to any third parties for any information obtained from the named customer contact, other than to the Crown Commercial Services and or contracting authorities defined by the Public Contract Regulations.

# 5.0 Evaluation Process

5.1 The process that will be used to select an appropriate Tenderer and award the contract for this procurement is available in more detail in the Evaluation Criteria.

The open procedure is a single stage process.

5.2 **Marking for Award Criteria**

An evaluation panel consisting of representatives of key stakeholders within RSSB will carry out the evaluation. The procurement team will only act as moderator during the assessment phases of the evaluation.

Each evaluation area is weighted to show the relative importance significance of the criteria specific area’s for assessment.

# 6.0 PROCESS AND PREPARATION OF RESPONSES

6.1 The Supplier shall not enter in any agreement or arrangement with any third party which would in any way cause RSSB or its members to incur any financial obligations to the Supplier or any third party.

6.2 The Supplier shall not approach any Customer employee, the Customer’s Representative or its agents to discuss any aspects of the Tender. All communication should be conducted via the Customers Representative.

6.3 The Supplier shall not canvass support for the award of the contract by approaching any employee of RSSB, its Representative or its agents.

6.4 The documents as enclosed are to be accepted in their entirety. No alteration Representative before the date stated for the receipt of tenders. If any alteration is made or these instructions to Suppliers are not fully complied with the tender may be invalidated.

6.5 The conditions of contract included in this Invitation to tender apply. The Suppliers standard terms of business or trade will not be accepted.

6.6 Any requested changes to the conditions of contract must be detailed on the Contract Issues Memo document included for consideration. If this is not completed, it is assumed that the Supplier has accepted all terms and conditions detailed and no further changes will be accepted.

6.7 The Supplier shall be deemed to have satisfied itself as to the nature, extent and the content of the goods, services or works to be provided, the extent of staff required and all other matters, which may affect the tender.

6.8 All prices quoted to be GBP (unless otherwise requested in the Invitation to Tender) exclusive Value Added Tax and firm.

It is the Suppliers responsibility to ensure the tender is correct at the time of submission. No amendment to the tender will be allowed after the due date.

6.9 Any questions must be emailed to the main point of contact no less than five days before the return date. Note: questions/responses will be circulated anonymously to all Suppliers invited to tender. Tenders received after the closing date and time will not be considered.

6.10 The Customers Representative reserves the right to correct any omissions or inaccuracies in the Invitation to Tender and to clarify and/or amend any of the Customers’ requirements, up to seven days before the return of tenders.

6.11 All information supplied by RSSB must be treated in confidence and not disclosed to third parties except insofar as this is necessary to obtain sureties or tenders required during the preparation of the Tender. All information provided by Suppliers will be treated in confidence except in stances where references may be sought.

6.12 RSSB reserves the right to cancel this Tender at any point and any cost incurred in the preparation of this Tender is at the Bidder’s expense.

6.13 Tenders must remain open for acceptance for a period of 180 calendar days from the submission date.

6.14 The tenderer should include the following information as part of their tender response:

Legal entity name of Tenderer

|  |
| --- |
|  |

Contact person's name, email address, telephone number and postal address for enquiries relating to this procurement

|  |
| --- |
| Name: |
| Postal address: |
| Telephone number: |
| Email address: |

Tenderer’s registered address

|  |
| --- |
|  |

Tenderer’s website address (if available)

|  |
| --- |
|  |

Please tick the box for the legal form of the Tenderer

|  |
| --- |
| * Sole Trader * Partnership * Limited Liability Partnership * Private Limited Company * Public Limited Company * Local Council * Voluntary/ charitable/ not for profit organisation * Other (please specify below) |

If ‘Other’ has been selected from the question above please provide details.

|  |
| --- |
|  |

If your business is a registered company, charity or any other registered organisation (including limited, non-limited or Industrial and Provident Society), please state your registration number. This must be the registration number of the Tenderer, providing the country and date of incorporation / registration if other than the UK.

|  |
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|  |

Name of ultimate parent company (if this applies)

|  |
| --- |
|  |

Companies House Registration number of ultimate parent company (if this applies)

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| --- |
|  |

**Additional Notes**

* Fully answer the question given and consider the weighting for the section
* Explain how you will meet the criteria and provide evidence to support your response.
* Further reading on how to complete the tender is available in section 10

# 7.0 TENDER EVALUATION (SELECTION CRITERIA)

|  |  |  |
| --- | --- | --- |
| **Selection criteria** | **Detail** | **Evaluation Criteria** |
| **S1** Supplier’s organisational experience in pantograph systems.  [Max 1 page] | The tenderer should provide a short description of at least 2 projects completed within the past 5 years that involved specialist work undertaken on pantograph systems. | Pass: The tenderer provides a short description of at least two projects completed within the past 5 years that involved specialist work undertaken on pantograph systems. The tenderer in the provision of the short description of the two or more projects also must provide the dates pertaining to these, showing that they have been completed within the past 5 years. Further, through the above the tenderer provides RSSB with a strong degree of confidence in its experience with pantograph systems.  Fail: The tenderer either fails to provide a short description of at least two projects completed within the past 5 years that involved specialist work undertaken on pantograph systems, or fails to provide the dates outlining that the projects have been completed within the past 5 years or fails to provide RSSB with sufficient confidence in its experience.  **Note:** Should a tenderer be scored a “Fail” at this stage the tenderers bid/submission will not be evaluated beyond this question. |
| **S2** Supplier’s organisational experience in assessing alternatives and improvements to train systems using comprehensive engineering/ technical approaches and an economic assessment.  [Max 1 page] | The tenderer should provide a short description of at least two projects/contracts completed within the past five years that involved developing technical specifications coupled with an economic evaluation of the solution. | Pass: The tenderer provides a short description of at least two projects or contracts completed within the past five years that involved developing technical specifications coupled with an economic evaluation of the solution. Further, the tenderer in the provision of the short description of the two or more projects also must provide the dates pertaining to these, showing that they have been completed within the past 5 years. Further, through the above the tenderer provides RSSB with a strong degree of confidence in its experience/  Fail: The tenderer either fails to provide evidence of at least two projects or contracts completed within the past five years that involved developing technical specifications coupled with an economic evaluation of the solution or fails to provide the dates pertaining to these, showing that they have been completed within the past 5 years or fails to RSSB with sufficient confidence in the tenderers experience.  **Note:** Should a tenderer be scored a “Fail” at this stage the tenderers bid/submission will not be evaluated beyond this question. |
| **S3** Supplier’s organisational experience and knowledge in communicating with and managing different rail stakeholders (RUs) within the GB rail industry.  [Max 1 page] | The tenderer should provide a short description of at least two projects/contracts completed within the past five years that focused on the GB rail industry, where different rail stakeholders (RUs) had to be managed, and where technical outputs from a project were communicated and promoted to rail groups/committees. | Pass: The tenderer provides a short description of at least two projects or contracts completed within the past give years that focused on the GB rail industry, where different rail stakeholders (RUs) had to be managed, and where technical outputs from a project were communicated and promoted to rail groups/committees. Further, the tenderer in the provision of the short description of the two or more projects also must provide the dates pertaining to these, showing that they have been completed within the past 5 years. Additionally, through the above the tenderer provides RSSB with a high degree of confidence in its experience.  Fail: The tenderer either fails to provide a short description of at least two projects or contracts completed within the past give years that focused on the GB rail industry, where different rail stakeholders (RUs) had to be managed, and where technical outputs from a project were communicated and promoted to rail groups/committees or fails to provide in the provision of the short description of the two or more projects the dates pertaining to these, showing that they have been completed within the past 5 years or fails to provide RSSB with a high degree of confidence in the tenderers experience.  **Note:** Should a tenderer be scored a “Fail” at this stage the tenderers bid/submission will not be evaluated beyond this question. |
| **S4** Summary of the proposal .  [Max 1 page] | The tenderer must provide a concise summary highlighting their ability to promote and contextualise their proposal. | Pass: The tenderer has provided a concise summary highlighting the key aspects of their proposal.  Fail: The tenderer has not provided a concise summary or has not provided a summary highlighting the key aspects of their proposal.  **Note:** Should a tenderer be scored a “Fail” at this stage the tenderers bid/submission will not be evaluated beyond this question. |

# 8.0 TENDER EVALUATION (AWARD CRITERIA)

8.1 **ITT Assessment**

**The Contract Award decision is solely based on the basis of Tenderer proposal and price offering.**

8.2 RSSB uses the following quality / price ratio to determine the outcome of the evaluation where quality (technical evaluation) and price are weighted and scored individually before being combined.

Quality 80%: Price 20%

8.3 Technical criteria are weighted and scored as a percentage of the maximum score available with a minimum quality threshold set.

**Technical Evaluation**

8.4 Tenders are assessed on how well they satisfy the technical evaluation criteria.

The relative importance of each criterion is established by giving it a percentage weighting so that all the weightings equal 100%. The Evaluation Matrix provides details of the weightings that RSSB will use in assessing Tenderer proposals.

The Technical Evaluation will be carried out using Tenderer responses to the tender specification using the scoring scheme (identified in Table below).

8.5 The scored responses are generally assessed out of a maximum of five (5). The Evaluation Panel will not be allowed to give partial scores (for example 3.5); however, once all scores are aggregated, the technical scores will be rounded to two decimal places prior to consolidating with the price evaluation.

8.6 The following shall constitute a failure to evidence satisfactory delivery of the requirement(s) of the procurement and will automatically disqualify the Tenderer:

1. A grade of zero (0) in any of the evaluated technical/quality questions in Section D of Schedule One (a) of Part B of the ITT before the weightings are applied; or
2. a grade of one (1) in more than one of the evaluated technical/quality questions in Section D of Schedule One (a) of Part B of the ITT before the weightings are applied

8.7 Those Tender Responses which fail to demonstrate satisfactory delivery of the requirement(s) of the procurement by reason of failing to achieve these minimum thresholds will be set aside and not considered further.

|  |  |
| --- | --- |
| **Grade** | **Definition of grade** |
| 5 | An Excellent Tender Response that (where applicable):   * Addresses all aspects of the question in an informed and comprehensive manner; * Demonstrates a thorough understanding of what is being asked for; * Provides evidence of how that understanding can be applied in practice; * Offers full confidence that the Tenderer will deliver the service in full; * Addresses the majority of areas of doubt and uncertainty; and * Provides certain, unambiguous commitments or statements of intent that permit reliance through translation into contractual terms |
| 4 | A Good Tender Response that (where applicable):   * Addresses all aspects of the question and is generally of a good standard; * Demonstrates a good understanding of what is being asked for; * Provides a worked-up methodical approach; * Offers confidence that the Tenderer will deliver the service in full, with limited areas of doubt or uncertainty; * Addresses key areas of doubt and uncertainty; and * Provides commitments that can be translated well into contractual terms |
| 3 | A Satisfactory Tender Response that (where applicable):   * Addresses the majority of the question and is generally of a good standard but lacks substance or detail in some areas; * Demonstrates an understanding of what is being asked for; * Provides a satisfactory approach; * Offers a general level of confidence that the Tenderer will deliver the service (but with room for doubt in some areas); * Address some areas of doubt and uncertainty; and * Provides some commitments that can be translated well into contractual terms. |
| 2 | A Poor Tender Response that (where applicable):   * Addresses some of the question but either lacks relevant information and detail or lacks substance in a manner that would suggest the response is a “model answer”; * Demonstrates some understanding but with a lack of clarity in key areas; * Provides an approach which is not wholly appropriate or viable or lacks evidence; * Shows that the level of confidence that the supplier can deliver does not outweigh the doubt; * Does not address many areas of doubt and uncertainty; and * Does not offer sufficient commitment (with doubt as to the extent to which would translate into contractual terms). |
| 1 | An Unsatisfactory Tenderer response that (where applicable):   * Does not address the question or has omissions; * Lacks understanding in significant areas: * Provides an approach which has gaps or creates concerns; * Shows that the level of confidence that the supplier can deliver is low; * Creates uncertainty; and * Displays significant lack of commitment (with doubt as to the extent to which would translate into contractual terms) |
| 0 | An Unacceptable Tenderer response that (where applicable):   * Provides no response or omissions/oversights that prevent scoring; * Refuses to deliver the requirement; and * Creates concerns so significant that the response would be detrimental to the interests of RSSB |

# 9.0 ITT Evaluation Matrix (Award Criteria)

|  |  |  |  |
| --- | --- | --- | --- |
| **Heading** | **Specific question(s)** | **Evaluation Criteria** | **Weight** |
| A1 Robust methodology and ability to apply it to client’s needs.  [Max 6 pages] | The tenderer provides a method statement of how it is intended to deliver against all aspects of the work package objectives of this work.  This should include:   * How the necessary data sets and information from RUs will be obtained:   + for cost-benefit evaluations of ADD systems and wear management strategies   + for a Whole Life Cycle analysis of carbon collection strips. * The methodology that will be used to:   + review the practice of RUs on carbon strip wear management   + review existing ADD systems available in GB rail and outside, and the performance of the system during dewirements   + specify the acceptable operational condition of collector strip (wear level).   + undertake a performance risk assessment and safety integrity evaluation of the proposed ADD system. | The Tenderer’s response:   * Demonstrates their understanding of the objectives and provide a coherent and systematic approach to meeting all the objectives. * Proposes a sound and credible approach/methodology for:   + obtaining the necessary data sets and information from RUs   + undertaking the review of carbon strip wear management strategies and ADD systems   + specifying the acceptable level of carbon wear   + undertaking a performance risk assessment and safety integrity evaluation of the proposed ADD system | 35% |
| A2 Independence, Knowledge and expertise in subject area  [Max 4 pages] | Detail the knowledge and expertise of the team who will be undertaking this work, relevant to carbon wear management (T1161-02) and ADD (T1161-03) work package objectives.  How will the tenderer apply their knowledge, expertise and skills to meet the objectives of this work?  How will the team ensure fair, independent, and impartial outputs are delivered? | The Tenderer’s response includes:   * Evidence of their knowledge and expertise in the subject. * Evidence of their technical competence in carbon collector strips, ADD systems, and economic evaluation of technical solutions. * Describes how they will apply knowledge, expertise, and technical competence to deliver the objectives. * Evidence of team independence and impartiality. | 20% |
| A3 Competence in communication, and engaging and managing of stakeholders.  [Max 2 pages] | How will the tenderer manage and engage multiple stakeholders, including during the industry workshops / interviews, to ensure industry expertise is incorporated into the outputs of the work?  How will the tenderer manage and negotiate multiple stakeholder views to ensure the outputs provide a balanced, fair and unbiased representation of industry expertise in the outputs?  How will effective communication be achieved with key stakeholders? | The tenderer’s response demonstrates:   * Experience of effectively engaging and managing multiple stakeholders. * Provides a well thought out and appropriate communication plan for communication between the tenderer and key stakeholders, to ensure the quality and content of the work is fit for purpose. * The tenderer has detailed potential approaches for managing and negotiating multiple stakeholder views to ensure the outputs provides a balanced, fair and impartial evidence-base of industry expertise. | 10% |
| A4 Project Delivery, resources and risk  [Max 3 pages] | Please identify the key roles and responsibilities that are essential to deliver the requirements of this work.  How will adequate allocation of appropriate resources be made against each deliverable?  How will the team ensure the quality and the content of the deliverables are fit for purpose?  What is the schedule that each task will be delivered against?  What are the key project risk and how does the tenderer propose to manage and mitigate them? | The tenderer’s response:   * Identifies relevant individuals to deliver the work and demonstrates that the mix of skills covered are appropriate to deliver the project. * Provides a credible plan for delivering successful outcomes to time, quality and cost, including details of allocated effort to activities. * Identifies appropriate risks and mitigations through the use of a risk register. | 15% |
| A5 Cost of project | Provide a fixed cost for the project and the associated cost break down. Describe how and why this represents value for money. | The tender with the lowest total cost will receive 100% of the available weighted score (20%).  Other Tenderer’s tenders will receive a pro-rated relative to the lowest cost according to the following formula:  Score of other tender = lowest tender total cost / other tender total cost x 100%. | 20% |

# 10.0 PRICE EVALUATION

10.1 All prices quoted shall be in sterling (unless otherwise requested in the Tender Documents), exclusive of Value Added Tax and shall be firm.

10.2 A full and comprehensive breakdown of all costs and expenses to provide the goods, services or works requested in this invitation to tender must be provided and all assumptions must be clearly stated.

10.3 Failure to provide adequate detail may cause your tender to be judged non-compliant.

10.4 The construction of the price must be clear and easy to understand. Where appropriate the use of tables to show pricing is preferred. We require the following information:

* + - A breakdown by grade and named individual, indicating the number of days to be worked on each task and the daily rate to be charged.
    - A list of sub-contracts with prices and copies of quotations where available (a similar breakdown by grade, named individuals and rates, as above, is required where the sub-contract is for manpower).
    - Details of any other costs, such as hire charges for equipment.
    - Details of travel and subsistence and all expenses to be incurred. Mileage reclaim will be linked to maximum levels set by HMRC.
    - The above breakdowns should be further broken down into individual work packages.

# 11.0 TENDER EVALUATION CRITERIA AND MINIMUM REQUIREMENTS

11.1 In evaluating tenders, the most economically advantageous tender(s) will be sought. This will be using the evaluation criteria and weightings detailed in **ITT Evaluation Matrix** **Award Criteria**.

11.2 The evaluation criteria detail the minimum requirements. Therefore, any tender which cannot demonstrate that it meets any of the minimum requirements will not be marked and will automatically score zero.

Tenderers are advised to carefully consider the attached specifications, ask clarification questions to ensure these are understood.

# 12.0 CONDITIONS OF CONTRACT

The terms and conditions of the contract are contained with a separate document.

**Qualification of the Contract**

Where Tenderers have any queries or concerns with any specific condition of the terms and conditions of the contract, these should be submitted in writing to **shareditt@rssb.co.uk** as soon as possible, and in any case no later than 10 days prior to the deadline for submission of tenders.  Please ensure the specific condition(s) and proposed amendment(s) are provided.  These will be reviewed by RSSB on a case by case basis, and, if accepted, revised terms and conditions will be issued to all Tenderers.  Failure to accept the terms and conditions of the contract or to qualify the tender in any way, may result in the tender being rejected by RSSB.

## 13.0 RSSB Company Information

***Insert Work Package Title*Introduction**

RSSB was established in April 2003. The Company’s primary objective is to facilitate the railway industry’s work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public. The railway is a complex system with multiple interfaces delivered by many different organisations. At RSSB we bring these different organisations together to make collective decisions. We help the rail industry carry out research, understand risk, set standards and improve performance. We provide a constant point of reference in a changing environment.

We support rail in the areas of safety standards, knowledge and innovation and a wide range of cross- industry schemes requiring our knowledge and independence. Our work involves close collaboration, but as technical experts we also appoint suppliers in the wider market to provide an informed view.

**Key elements of the company’s remit are to:**

* Manage Railway Group Standards on behalf of the industry
* Lead the development of long-term safety strategy for the industry, including the publication of annual Railway Strategic Safety Plans
* Propose change through facilitation of the research and development programme, education and awareness
* Measure, report and inform on health and safety performance, safety intelligence, trends, data and risk
* Support cross-industry groups in national programmes which address major areas of safety concern
* Facilitate the effective representation of the UK rail industry in the development of European legislation and standards that impact on the rail system

RSSB is a not-for-profit company owned by major industry stakeholders. The company is limited by guarantee and is governed by its members, a board and an advisory committee. It is independent of any single railway company and of their commercial interests.

# Background

## RSSB Overview

*RSSB* is a membership organisation in the railway that helps industry by understanding risk, guiding standards and managing research. The rail industry in Britain is made up of many different organisations, but they all form a system and share a common purpose, to move people and freight safely and efficiently by rail. *RSSB* brings all parts of this system together to make collective decisions, products and services, to help industry drive out unnecessary cost, improve business performance and develop long-term strategies.

*RSSB’s* activities include:

* **Understanding risk –** Using safety intelligence from across the rail industry and elsewhere with the latest risk modelling to inform members and support safe decision making.
* **Guiding standards** – Creating, reviewing and simplifying GB standards to align with European requirements; managing the *Rule Book* and making it easier for the railway to deliver efficiently and safely.
* **Managing research, development and innovation** – Undertaking, commissioning and managing research and innovation programmes to address current needs, provide knowledge for decision making now and for the future, and promoting step changes to deliver the *Rail Technical Strategy*.
* **Collaborating to improve** – As an independent cross-industry body with a critical mass of technical expertise, supporting activities which require collaboration. These range from supplier assurance schemes (*RISQS, RISAS*) to confidential reporting (*CIRAS*), from health and wellbeing strategies to sustainability principles.

**Specification for research project**

T1161 Improvements to pantograph collector strips maintenance and to Automatic Dropping Device

# RSSB overview

RSSB is a membership organisation that supports the GB rail industry by:

* **Understanding risk** – Using safety intelligence with the latest risk modelling to inform members and support safe decision making.
* **Guiding standards** – Creating, reviewing and simplifying GB standards; managing the Rule Book and making it easier for the railway to deliver efficiently and safely.
* **Facilitate cross-industry collaboration** – As an independent cross-industry body, supporting activities which require collaboration such as supplier assurance schemes, confidential reporting and developing industry strategies.
* **Managing research, development and innovation** – Undertaking, commissioning and managing research and innovation programmes to address current and future needs and provide knowledge for decision making; supporting implementation and promoting step changes to deliver industry strategies.

# Pantograph and OLE interaction research

The Vehicle/Train Energy System Interface Committee (V/TE SIC) assists the rail industry in evaluating and managing the key power supply system interfaces. As part of its remit, it also identifies losses, and likely remedies, in the energy transmission system; promotes more efficient energy use; and develops longer-term, sustainable energy strategies. V/TE SIC has identified multiple challenges related to the pantograph, the Overhead Line Equipment (OLE) and their interfaces and this project covers two of them.

# Project background

This research focuses on:

1. Identification of cost-effective wear management strategies together with novel technological options for the collector strip.

The collector strips (or carbon strips) in contact with the OLE contact wire are the key component for the transmission of electrical energy between OLE infrastructure and the train. When the train is in motion, the strips are subjected to abrasion, electrical damage and fatigue eventually reaching their electrical and mechanical engineering limits. Hence, they must be regularly inspected and renewed (every 10-30 weeks[[1]](#footnote-1)).

1. Improvements to the Automatic Dropping Device (ADD), a component of the pantograph.

Closely allied to the collector strips is the ADD, a feature of most pantographs operating on Network Rail infrastructure. Its role is to drop the pantograph in the event of significant damage to the pantograph head and/or collector strips as a protective measure. Further damage to the pantograph and strip could lead to dewirement.

Dewirements are a significant cost to the industry with safety implications (major dewirement incidents include injuries to passengers and/or track workers), but they primarily impact the performance and reliability of the service. This project will contribute to improving the reliability and performance of pantographs while reducing maintenance costs, system failure costs and to some extent, reducing dewirement delay costs and incidents.

**T1060[[2]](#footnote-2) (RSSB, 2018)** looked at past dewirement cases and identified some causes and risks. The report recommended to review the effectiveness of the ADD system in preventing or mitigating the escalation of dewirement events. It noted that in a proportion of cases, the ADD position on the pantograph assembly is not always optimised for all rolling stock types. The project also identified opportunities to improve the ADD system.

Although, the definition of dewirement excludes regular wear and tear of OLE wires or pantograph carbon strips, they can become contributory factors to a more damaging event if not managed properly. There has been discussion at the VTE SIC around the need for an agreed industry position on the wear of pantograph collector strips. Network Rail Ltd is working with suppliers and the University of Milan to understand wear on the OLE, but no work has been undertaken to understand collector strip wear. Currently, there is an inconsistent approach across the industry to manage collector strip wear and no Whole Life Cycle (WLC) analysis is available to inform this.

The other highly relevant piece of research, **T346[[3]](#footnote-3) (RSSB, 2012)**, investigated the potential for improvements in electrification systems. It provided an assessment of the latest technological developments in both collector strips and ADD, laying down the areas for further improvements (e.g. alternative carbon material with lower wear rate and alternative ADD systems with faster response times). The project also identified the need for more reliable means of indicating ADD activation to the train driver. Current systems are inadequate where, for example, an ADD indication may be overridden by another fault or where the driver of a multiple coupled Electric Multiple Units receives no indication of a trailing pantograph ADD activation.

The outcome of T1161 will be information such as performance criteria and functionality required to enable the specification of National Technical Rules (NTR) and industry guidance documents regarding ADD and carbon strips (maintenance strategy and technological improvements). These rules and guidance documents would include best practice in carbon strips wear management minimising the maintenance cost and improving the reliability as well as ADD system specifications with faster response time, improved fault detection systems, and optimal locations for different rolling stock types.

The specification documents and NTR are aimed at rolling stock manufacturers and suppliers, Infrastructure Managers (IMs) and Railway Undertakings (RUs). It is expected, however, that the specifications will be finalised after a validation phase of the findings of this project. This could be done through laboratory and/or real-world testing and will be undertaken as a separate project. The timing is right to undertake this research as the rail standards, namely GM/RT2111 and GL/RT1210, for the pantograph/OLE interface are proposed to be updated.

# Project objectives

The project sets out to achieve the following objectives:

* To develop an agreed scale and description for the wear of the pantograph carbon collector strips;
* To propose a cost-effective maintenance strategy for the carbon collector strips;

An optimal strategy could, for instance, be a combination of new material and maintenance regime. Therefore, the output could be a selection of acceptable material and their respective maintenance regime.

* To define the performance characteristics for an improved ADD system.

By assessing a cost-effective wear strategy and ADD technological options, and then defining the associated industry requirements, this project should provide information for incorporation into revised GM/RT2111 and GL/RT1210.

# Project structure

This project is structured in three work packages, **of which Work Packages T1161-02 and T1161-03 are subject to tender**.

|  |  |
| --- | --- |
| Work Package T1161-01 | |
| **Title** | Improvements to pantograph collector strips maintenance and to Automatic Dropping Device – RSSB Internal Project Development |
| **Delivery** | RSSB |
| **Start** | 12 September 2018 |
| **Completion** | 30 November 2018 |
| **Deliverables** | * T1161 Business case * T1161 Project specification |

|  |  |
| --- | --- |
| Work Package T1161-02 | |
| **Title** | Pantograph collector strips wear condition and optimal maintenance strategy – External Delivery |
| **Delivery** | Competitive tender |
| **Start** | 4 February 2019 |
| **Completion** | 31 October 2019 |
| **Prerequisite** | Access to data and information on carbon collector strips |
| **Associated break point** | If it is not possible to access information that can be used in a cost-benefit analysis to identify the best maintenance strategy and specify wear condition, then this may act as the break clause leading to the early termination of this work package. |
| **Deliverables** | * Final report * Draft specification document (standalone) * Research brief * Presentation |

|  |  |
| --- | --- |
| Work Package T1161-03 | |
| **Title** | Requirements for an improved ADD system - External Delivery |
| **Delivery** | Competitive tender |
| **Start** | 4 February 2019 |
| **Completion** | 31 October 2019 |
| **Deliverables** | * Final report * Draft specification document (standalone) * Research brief * Presentation |

# Work package objectives

The objectives for Work Package **T1161-02 and T1161-03** are detailed below.

### Work package T1161-02

This work package sets out to:

* Review the practice of RUs on carbon strip wear management.
* Specify the acceptable operational condition of collector strip (wear level) without any impact to reliability and safety. This needs to be carried out for different materials available today and those anticipated in the future. The evaluation should include consideration of a business case, safety integrity and past research (T346).
* Undertake a cost-benefit analysis and a whole life cycle analysis of the various strategies in GB rail and outside for wear management, taking into account anticipated new materials and technologies, and their common failure modes.
* Suggest an optimal wear management strategy (best-practices) which could be a selection of acceptable material and their respective maintenance regime.
* Draft an industry guidance document and NTR.
* High-level description of the validation methodology proposed for potential follow up work (laboratory testing/ real world testing)

### Work package T1161-03

This work package sets out to:

* Review existing ADD systems available in GB rail and outside, and the performance of the system during dewirements.
* Propose options for improved system requirements based on findings and past recommendations (T346 and T1060) and carry out a cost-benefit analysis for the railway industry.
* Propose updates to GM/RT2111.
* High-level description of the validation methodology for Phase 2 proposed for potential follow up work (laboratory / real-world testing)

# Work package scope

This section defines the tasks to be tendered against, and the technical content against which the submissions will be assessed.

### Work package T1161-02

### In scope

The following aspects are to be addressed in the tenderers’ response:

* Technical assessment of the common failure modes (e.g. [wear mechanism](https://www.emeraldinsight.com/keyword/Wear+Mechanism) and rate, [arc erosion](https://www.emeraldinsight.com/keyword/Arc+Erosion), [delamination wear](https://www.emeraldinsight.com/keyword/Delamination+Wear)) of different contact strip materials in use in GB rail and internationally and novel ones (e.g. graphene, padded carbons[[4]](#footnote-4)).
* Whole Life Cycle analysis.
* Consideration of weathering, and degradation in winter condition where strips need to operate at higher temperatures.
* Consideration of chemical wear (induced by neighbouring materials in contact with strips)
* Consideration of fatigue of the material based on different typical pantograph duty cycles.
* Collation of necessary data sets/information from RUs for cost-benefit analysis.
* Suggestion of a methodology for laboratory and real-world testing of the maintenance strategy and the chosen collector strip material.
* Exploration of retrofitted solutions and more adventurous ones (e.g. no pantograph collector strip).
* Ensuring that the technical solutions developed work together with existing systems or proposed new ones, as well as requirements defined from work package T1161-03.

### Out of scope

Laboratory testing and real-world testing is out of scope in this stage, and OLE wear research is out of scope.

### Work package T1161-03

### In scope

The following aspects are to be addressed in the tenderers’ response:

* Review of ADD positioning, fault detection and reporting systems.
* Collect ADDs occurrence data and undertake a performance risk assessment of the component, especially during dewirements.
* Cost-benefit analysis while taking into account international and new build ADD systems or alternative systems (e.g. retrofitted) including those anticipated in the future.
* Safety integrity evaluation of any new proposed ADD (e.g. fibre optic alternatives).
* Development of text that is suitable for incorporation into standards that details technical specifications and text that can be inserted into a guidance document.
* Exploration of retrofitted solutions.
* Ensuring that the technical solutions developed work with existing systems and proposed solutions from work package T1161-02.
* Proposition of a high-level validation methodology of the findings (lab testing/ real-world testing).

### Out of scope

Laboratory testing and real-world testing is out of scope in this stage.

# Work package deliverables

This project will provide the following deliverables:

### Work package T1161-02

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-02 – ‘Pantograph collector strips wear condition and optimal maintenance strategy’ |
| **Deliverable Type** | Final report |
| **Description** | This report details the practices of RUs on collector strip wear management and defines an optimal management strategy with consideration to various existing materials and novel/anticipated ones. It explains the reasons for which this strategy is efficient and employs a cost-benefit approach in the analysis as well as a whole life cycle analysis. The report elaborates upon the safe operating wear condition of the best materials with consideration to the business case, safety integrity and reliability of the system. It suggests a methodology for laboratory and real-world testing. |
| **Publication** | The report will be reviewed by the project steering group and RSSB, and will be subsequently finalised by the supplier. The report will be produced in a RSSB Microsoft Word template and will be made widely available. It is to be written to allow industry to better understand optimal management strategies of pantograph collector strip wear. We expect the final report to generate an important conversation amongst those in the industry which will be set to (potentially) benefit from any positive findings.  **This is due to be delivered by August 2019 and published by the end of October 2019.** |

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-02 – ‘Technical specification of pantograph collector strips wear condition and maintenance’ |
| **Deliverable Type** | Draft specification document (standalone) |
| **Description** | Draft specification document written in a format similar to existing standards document on the subject (such as GM/RT2111 and GL/RT1210). It should specify technical solutions for collector strips and their maintenance regime. This will be based on the findings highlighted in the final report. Following validation, the intention is to finalise this document for incorporation into the relevant standards. |
| **Publication** | The draft document will be reviewed by the project steering group and RSSB. Publication of this document will depend on the need and timing of validation testing.  **This is due to be delivered by August 2019.** |

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-02 – ‘Recommendations for collector strips maintenance strategy (Key findings)’ |
| **Deliverable Type** | PowerPoint Presentation |
| **Description** | A presentation to be made available to industry to promote the material at Pantograph/OLE meetings and VTE SIC meetings.  This should cover the maintenance strategy proposed and its benefit to the industry. |
| **Publication** | **A presentation at VTE SIC after the project’s deliverables have been accepted.** |

### Work package T1161-03

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-03 – ‘Requirements for an improved ADD system’ |
| **Deliverable Type** | Final report |
| **Description** | This report provides a review of existing ADD systems available in GB rail and outside, with an emphasis where possible on the performance of these systems during dewirements. The report evaluates the options for an improved ADD system taking into consideration past recommendations (T346 and T1060) and new findings. The report will include a cost-benefit analysis of any new ADD system proposed and a safety integrity and reliability analysis.  There needs to be a suggested methodology for laboratory and real-world testing and if applicable recommendations should be made to update relevant standards and industry guidance documents based on the findings. |
| **Publication** | The report will be reviewed by the project steering group and RSSB, and will be subsequently finalised by the supplier. The report will be produced in a RSSB Microsoft Word template and will be made widely available. It is to be written for industry to understand improved ADD systems and consider the roll-out of such systems with considerations to their economic, reliability and safety justifications. We expect the final report to generate an important conversation amongst those in the industry which will be set to (potentially) benefit from any positive findings.  **This is due to be delivered by August 2019 and published by the end of October 2019.** |

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-02 – ‘Technical specification of an improved ADD system’ |
| **Deliverable Type** | Draft specification document (standalone) |
| **Description** | Draft specification document written in a format similar to existing standards document on the subject (such as GM/RT2111 and GL/RT1210). It should specify technical solutions for an improved ADD system including its optimal location on various types of rolling stocks and specification for a fault monitoring and reporting system. This will be based on the findings highlighted in the final report. Following Phase 2 (validation), the intention is to finalise this document for incorporation into the relevant standards and guidance documents. |
| **Publication** | The draft document will be reviewed by the project steering group and RSSB. This document will not be published until phase 2 – testing has been completed.  **This is due to be delivered by August 2019.** |

|  |  |
| --- | --- |
| **Deliverable Title** | T1161-03 – ‘Requirements for an improved ADD system (key findings)’ |
| **Deliverable Type** | PowerPoint Presentation |
| **Description** | A presentation to be made available to industry to promote the material at Pantograph/OLE meetings and VTE SIC meetings.  This should cover the requirements of an improved ADD system and justifications for a future roll-out. |
| **Publication** | **A presentation at VTE SIC after the project’s deliverables have been accepted.** |

|  |  |
| --- | --- |
| **Deliverable Title** | T1161 - Improvements to pantograph collector strips maintenance and to Automatic Dropping Device |
| **Deliverable Type** | Research Brief |
| **Description** | A four-page document summarising the research, its findings, and the potential benefits that help to raise awareness of the key findings and promote their adoption. |
| **Publication** | The short brief will be reviewed by RSSB.  **The draft is due to be delivered by August 2019 and published by the end of October 2019.** |

### Work package T1161-02 and T1161-03

# Work package methodology

Suppliers are expected to explain the methodology that they are intending to use to successfully meet the **work package requirements** of this work package. The work package requirements are detailed within the following sections:

* Work package objectives (Work Package T1161-02 and T1161-03)
* Work package scope
* Work package deliverables

The work package requirements are set in context by:

* Project background
* Project objectives
* Project structure

# Stakeholder roles and responsibilities

The key stakeholders and their responsibilities are detailed in the table below.

|  |  |  |
| --- | --- | --- |
| **Stakeholder(s)** | **General role in project** | **Specific role in acceptance of deliverables** |
| RSSB Project Manager | The RSSB Project Manager is the first point of contact during project delivery and is responsible for the detailed project management including project schedules, cost reporting and other relevant project management tasks.  The Delivery Manager leads the project in organising meetings, etc and ensures timely and effective delivery towards project objectives. | Facilitates technical review and acceptance processes, identifies and monitors corrective actions where needed, including facilitating decision making. |
| RSSB Technical Lead | Throughout the project, the RSSB Technical Lead ensures that technical aspects are reflected accurately.  Technical aspects can refer to specific issues around railway signalling, track engineering, safety relevant operations or any other specialist field. | Reviews emerging outputs from a technical perspective. |
| Industry sponsor | The industry sponsor acts as figurehead for the research, championing its importance and its outputs.  The industry sponsor forms part of the project steering group, however, their key role as sponsor is to provide steer to the research as it progresses and to exert pressure on industry to make use of its findings. | Reviews emerging outputs from a technical perspective. |
| Project steering group | The project steering group ensures the project delivers to industry needs. As such, it helps formulate specifications, assesses tenders, reviews draft and final outputs and other relevant tasks. | Reviews emerging outputs from a technical perspective. |
| Primary client group | The primary client group is made up of RSSB members and other stakeholders across industry.  The group is kept informed of the project’s progress each Period (4 weeks). A presentation is made by the supplier to inform the client group of the project’s deliverables. | Informed of deliverables. |

# Deliverables review process

The supplier submits the draft reports to the RSSB Project Manager. Following submission, the draft deliverables are reviewed in parallel by the RSSB Project Manager, RSSB Technical Lead and the project steering group (stakeholders are usually given two to three weeks to provide feedback). The Project Manager provides collated feedback to the supplier in order for the deliverables to be revised. Further revisions (as part of the contract) may be requested if previously identified issues have not been adequately resolved.

Following revision, the deliverables will be presented to the primary client group. The deliverables are then finalised and published by RSSB.

# Budget, timescales and responsibilities

This work has a budget of £130,000. If the fixed cost is above the budgeted amount, then a detailed explanation as to why any proposed increase is necessary, and what added value it may provide. In such cases, RSSB strongly encourages suppliers to provide costed options for consideration.

RSSB expects to award the contract by January 2019 for a prompt start at the beginning of February 2019 and conclude by October 2019. However, these are indicative dates and RSSB will consider bids that cannot meet these expectations if the supplier includes a robust project plan and an explanation as to why they cannot meet the preferred start and end dates, while still meeting the project objectives.

# Critical success factors and risk management

The following critical success criteria have been identified to help ensure successful delivery and to increase likelihood of industry acceptance/implementation:

* Improved insight into the limitations of current collector strips wear management strategies and ADD systems.
* Ability to propose options with robust justifications based a cost-benefit approach which can be implemented immediately (retrofitted solutions) or implemented in the next fleet of rolling stocks.
* Stakeholder (RSSB, Sponsor, Client Group) satisfaction with the project outputs.

The following project risks have been identified:

* Availability of datasets for a whole life cycle and a cost-benefit analysis.
* Stakeholder engagement and buy in.

A detailed risk and mitigations register should be provided as part of the submission illustrating required actions to support the success of the work package.

**Appendix X Form of Tender**

This section outlines how the offer from the Tenderer is to be constructed. Please return this Tender Declaration along with your Tender and retain a copy for your records.

Having examined the ITT email, the Instructions to Tenderers, the Information Required From Tenderers, the Conditions of Contract, the Specification and this Form of Tender (the “Tender Documents”), we offer to supply all/part of (delete as applicable) the goods, services or works specified in these Tender Documents.

We undertake if selected, to perform the contract in accordance with the Tender Documents, including the Conditions of Contract contained herein.

We agree that this tender shall remain open for acceptance by the Customer for 180 days from the date stipulated for the return of tenders.

We understand that you are not bound to accept the lowest, or any tender you may receive.

We certify that this is a bona fide tender, and that we have not fixed or adjusted the amount of the tender by or under or in accordance with any agreement or arrangement with any other person. We also certify that we have not done and we undertake that we will not do, at any time before the hour and date specified for the return of this tender, any of the following acts:

1. Communicate to a person, other than the person calling for the tenders, the amount or approximate amount of the proposed tender. Except where the disclosure, in confidence, of the approximate amount of the tender was necessary to obtain insurance premium quotations required for the preparation of the tender.
2. Enter into an agreement or arrangement with any other person that he shall refrain from tendering or as to the amount of any tender to be submitted.
3. Offer or pay or give or agree to pay or give, any sum of money or valuable consideration directly or indirectly to any person, for doing or having done or causing or having caused to be done, in relation to any other tender or proposed tender for the said goods, services or works, any act or thing of the sort described herein.

We recognise that the Customer reserves the right to clarify details of our offer prior to the award of any contract.

We hereby undertake that the period during which this tender remains open for acceptance not to divulge to any persons, other than the persons to whom the tender is to be submitted, any information relating to the submission of this tender or the details contained therein except where such is necessary for the purpose of submission of this tender.

**Appendix X Subcontractors**

All suppliers to RSSB are asked to provide details of all sub-contractors that will be used to perform the contract.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name & Address of Sub-Contractor | | Service performed for Contractor | Provide details of staff numbers[[5]](#footnote-5) | Provide latest year’s turnover |
| Name: |  |  |  |  |
| Address: |  |
| Name: |  |  |  |  |
| Address: |  |
| Name: |  |  |  |  |
| Address: |  |

**Appendix X Conflicts** **of** **Interest**

**Tenderers have a continuing duty to disclose actual or potential conflicts of interest in respect of itself, its named sub-contractors and / or consortia members.**

**Please describe any (potential) conflicts of interest that the Tenderer has identified and how these will be managed\*:**

If you **DO** **NOT** have any conflicts to declare, please tick this box:

Tenderers are reminded that failure to identify material conflicts of interest may lead to rejection of its tender response.

Guidance to Tenderers:

Tenderers should describe in the detail the perceived conflict (how it could be perceived in the context of this procurement) and the measures it will take to mitigate the conflict through the procurement life-cycle and service delivery

1. AWC Shing and P P LWong, Wear of pantograph collector strips, IMechE, 2008. [↑](#footnote-ref-1)
2. T1060: Understanding the forces and energy in the electrification system during dewirement, RSSB, 2018. [↑](#footnote-ref-2)
3. ## T346: Pantographs - collector strips and ADD systems, RSSB, 2012, <https://www.sparkrail.org/Lists/Records_StaffMembers/DispForm.aspx?ID=113>.

   [↑](#footnote-ref-3)
4. T346: Pantographs - collector strips and ADD systems, RSSB, 2012, <https://www.sparkrail.org/Lists/Records_StaffMembers/DispForm.aspx?ID=113>. [↑](#footnote-ref-4)
5. This is the average annual numbers of both staff and managerial staff employed over the last trading year [↑](#footnote-ref-5)