

Specification

**Research on performance test
procedures for petroleum road fuel
tankers;
Part C – Detailed Finite Element
Modelling (FEM) and Engineering
Critical Assessment (ECA)**
Department for Transport

Contract Reference: P4/030/013b

CONTENTS

1.	PURPOSE.....	3
2.	BACKGROUND TO THE CONTRACTING AUTHORITY.....	3
3.	BACKGROUND TO REQUIREMENT/OVERVIEW OF REQUIREMENT	3
4.	DEFINITIONS.....	5
5.	INDICATIVE PROCUREMENT TIMETABLE	5
6.	SCOPE OF REQUIREMENT	6
7.	THE REQUIREMENT	7
8.	OUTLINE OF OTHER WORK PACKAGE 5 RESEARCH (NOT REQUIRED AS PART OF THIS TENDER) – FOR INFORMATION ONLY	8
9.	KEY MILESTONES	8
10.	AUTHORITY'S RESPONSIBILITIES	9
11.	REPORTING	9
12.	CONTINUOUS IMPROVEMENT	9
13.	SUSTAINABILITY	9
14.	QUALITY	10
15.	PRICE	10
16.	STAFF AND CUSTOMER SERVICE.....	10
17.	SERVICE LEVELS AND PERFORMANCE	11
18.	SECURITY REQUIREMENTS.....	12
19.	DATA PROTECTION	12
20.	INTELLECTUAL PROPERTY RIGHTS (IPR)	12
21.	EVALUATION CRITERIA	12
22.	ARRANGEMENT FOR END OF CONTRACT	12
23.	PAYMENT	12
24.	LOCATION	12
25.	POINTS OF CONTACT	13

1. PURPOSE

- 1.1 The Department for Transport Dangerous Goods Division (DGD) intends to let a contract for the provision of detailed Finite Element Modelling (FEM) and Engineering Critical Assessment (ECA) of performance test procedures for technical assessments of petroleum road fuel tankers. This contract, referred to as Part C, is the subject of this Specification document, and together with Part A and Part B forms a series of research projects known collectively as WP5. It is anticipated that the outputs from WP5 will underpin UK proposals for performance-based test procedures to be included in relevant standards, a national technical code, a CEN Technical Report and/or regulations.

2. BACKGROUND TO THE CONTRACTING AUTHORITY

- 2.1 DGD leads on the policy for the safe and secure carriage of dangerous goods by road and rail and has oversight of the sea and air modes. Goods classified as hazardous are vital to our economy and a modern way of life, and can include chemicals for industry, fuel for transport and to heat and light our homes, or batteries which power our electric devices. Movement of such goods is essential, but it must be carried out in a way which minimises the risk of harm to people, property or the environment.
- 2.2 The Division's objective is therefore to ensure that the regulations continue to safeguard the carriage of dangerous goods, but in a manner that is proportionate and does not needlessly hinder trade. The division also exists to ensure that the UK compliance and enforcement framework is as effective as possible.
- 2.3 The DGD research programme derives from recent experience with non-compliant petrol tankers which could have led to the failure of some fuel deliveries. The programme supports implementation of lessons learned and further proportionate improvements to the design, construction, testing and inspection of tankers, so as to reduce the risk of non-compliance and avoid further issues. It will also support the UK negotiating position at international standards fora, minimising the risk of disproportionate regulations and backing the UK interest.

3. BACKGROUND TO REQUIREMENT/OVERVIEW OF REQUIREMENT

- 3.1 Since 2013, the Department for Transport DGD has successfully brought about the withdrawal from service of around 230 non-compliant petroleum tankers manufactured by GRW in South Africa. This withdrawal programme was based on robust evidence from research, which enabled the issue to be resolved without compromising road safety or disrupting fuel supplies. The research reports were published in December 2014 and November 2015 and can be found at www.gov.uk – search for “Petroleum road fuel tankers: technical assessment, December 2014” and “Petroleum fuel tankers: technical assessment, November 2015”.
- 3.2 More recently subsequent research has been completed on welded repairs and the assessment of BS EN 13094 lap and partition joint designs. This research also looked at end dish ruptures of tanks in rollover incidents and at meetings of the relevant standards working group, helped secure agreement on improvements to the tanker

- design and construction standard aimed at reducing the possibility of end dish ruptures in rollover incidents.
- 3.3 The research on welded repairs concluded, amongst other things, that the tanker service environment, the level of internal surface saturation and contamination that cannot be mechanically or chemically removed without loss of material thickness, and the weld repair practice adopted will have a significant influence on the success of a welded repair satisfying a commercial standard quality criteria for gas pore and porosity levels.
- 3.4 The conclusions of this research were taken into account during the preparation of preliminary guidelines for repairs and modification of tanks for the carriage of dangerous goods. Further work would be necessary if the procedures for welded repairs were to be improved.
- 3.5 Further research commissioned by DGD has informed the acceptance criteria for welding imperfections specified in EN 12972:2018 and, in a related package of work, informed state-of-the-art requirements for finite element analysis of other aspects of tanker design during the development of a revised version of standard EN13094:2015 to be adopted into regulations for July 2023.
- 3.6 A further set of linked research projects, known collectively as Work Package 5, will establish performance-based safety test procedures for petroleum fuel tankers that may be used as an alternative to the constraints of the existing design and construction rules. This Statement of Requirements document relates specifically to sub-package Part C, which is to provide for detailed Finite Element Modelling (FEM) and Engineering Critical Assessments (ECAs) of the impact conditions. Two other sub-packages are being commissioned separately, but aside from the peer review requirements, these are not directly relevant to this Statement; Part A is to better define the impact scenarios to be used (based on a review of accident data, impact conditions and regulations) and Part B is to conduct the physical testing and the associated modelling to help develop the physical tests.
- 3.7 It is anticipated the new test procedures will enable manufacturers to develop tank shells using design and construction methods not necessarily depicted in the standards, but which are nevertheless able to sustain rollover, frontal, rear and side impacts without having to use a series of more costly full-scale tests. In so doing, the new test procedures will reduce barriers to new tanker designs and construction technologies, and further improve the regulations and standards.
- 3.8 For any new test procedures to be used in the construction of petroleum road fuel tankers they would need to be specified in relevant standards, a national technical code, a CEN Technical Report and/or regulations. EN 13094 Design and Construction – Gravity discharge tanks and EN 12972 Testing, inspection and marking of metallic tanks are the standards referenced in ADR for the design, construction, inspection and testing of petroleum road tankers.

4. DEFINITIONS

Expression or Acronym	Definition
ADR	Accord Dangereux Routier (regulations concerning the international transport of dangerous goods by road).
DGD	Department for Transport Dangerous Goods Division.
WP5	Work package 5 of the DGD petroleum road fuel tankers research programme.
ECA	Engineering Critical Assessment - an analysis, based on fracture mechanics principles, of whether a given flaw is safe from fracture, fatigue, creep or collapse under specified loading conditions.
FEM	Finite Element Modelling
GMH	Department for Transport, Great Minster House, 33 Horseferry Road, London, SW1P 4DR.

5. INDICATIVE PROCUREMENT TIMETABLE

Description	Date
Publication of the ITT	Monday 10 th February 2020
Clarification Period starts	Monday 10 th February 2020
Clarification Period closes	Monday 24 th February 2020 (12:00 Midday)
Tender Clarifications Deadline	
Deadline for the publication of responses to Tender Clarification questions	Wednesday 26 th February 2020 (17:00)
Deadline for submission of Tenders	Monday 2 nd March 2020 (12:00 Midday)
Tender Submission Deadline	
Commencement of Evaluation Process	Monday 2 nd March 2020 (12:00 Midday)
Conclusion of Evaluation Process	Monday 9 th March 2020
Potential Conclusion of Standstill Period	Monday 23 rd March 2020
Potential Contract Award	Tuesday 24 th March 2020
Potential Contract Signature	Wednesday 25 th March 2020
Potential Contract Commencement	Friday 27 th March 2020

6. SCOPE OF REQUIREMENT

- 6.1 The summary scope of the work of Part C is to provide robust detailed FEM and ECA of petroleum road fuel tankers involving rollover, frontal, rear and side impacts, and to support the wider fuel tanker research via peer review. Rigid and articulated heavy goods vehicle tankers are in scope of this research.
- 6.2 The detailed scope of the work of the Part C Provider is to provide:
- 6.2.1 Detailed Finite Element Modelling (FEM) of selected road fuel tankers designed to the ADR construction rules to determine a benchmark of performance under rollover, frontal, rear and side impacts.
 - 6.2.2 Detailed ECAs of particular failure mechanisms and predictions of structural failures and tank ruptures, capable of highlighting any deficiencies that could affect safety in accidents and under normal service conditions.
 - 6.2.3 Support to the wider WP5 fuel tanker research via peer review.
- 6.3 In addition, and to be costed separately as an option to be taken up only if, as and when deemed necessary by DGD, it is anticipated that the provider's senior technical lead for this work, or a suitably qualified and knowledgeable alternate, may be asked to provide support to DGD by participating at some or all of the following additional domestic and international meetings. Respondents should provide fixed return travel costs and per day/night costs for accommodation, subsistence and/or meeting attendance on a per meeting basis.
- 6.3.1 Meetings and/or national events with domestic stakeholders responsible for design, construction, testing and inspection of petroleum fuel tankers (normally held in a mutually convenient location in the UK). Support and participation at such meetings and/or national events on up to four occasions.
 - 6.3.2 Meetings of national experts and relevant standards working groups; usually held at BSI (Chiswick) and VdTUV (Berlin). Support and participation at such meetings on up to six occasions (please distinguish between costs for individual Chiswick meetings and Berlin meetings).
 - 6.3.3 The UN ECE Joint Meeting Informal Working Group on the inspection and certification of tanks (normally held in London or by exception elsewhere at a mutually convenient location for the Contracting Parties of the European agreement on the ADR) or the UN ECE Joint Meeting Working Group on tanks (normally held in Geneva in September and Bern in March). Support and participation at such meetings on up to three occasions (please distinguish between costs for individual London meetings and meetings in Switzerland).

7. THE REQUIREMENT

- 7.1 The Department requires a provider to successfully deliver the Part C fuel tanker FEM and ECA research to technical, time and budget requirements, producing outputs of a quality that would, if appropriate, withstand the detailed scrutiny that underpinning proposals to amend the relevant standards and/or regulations, or create a national technical code or a CEN Technical Report, would entail. As a minimum it is anticipated this will require the successful provider to:
- 7.1.1 Develop one or more FE model(s) representative of banded and stuffed tanks typically used in the UK.
 - 7.1.2 Validate the FE model(s) for the rollover, frontal, rear and side impact conditions, informed by the results of the previous (2014/15) research and the research being conducted separately under parts A and B.
 - 7.1.3 Demonstrate that the FE model developed is sufficiently robust to allow various static structural and dynamic (impact) loads to be applied. Where appropriate, e.g. to reduce costs or model complexity, simplifications can be made but these must be justified.
 - 7.1.4 Make full and appropriate use of the FEM and ECA techniques used and findings arising from the analyses of fuel tanker fatigue and impact loading scenarios published in 2014/15.
 - 7.1.5 Undertake detailed FEM and ECA analyses as appropriate to assess local collapse and likelihood of rupture for each impact / test condition selected in Part B, taking into account the effects of fatigue depending on the available data.
 - 7.1.6 Predict crack growth and the likely fatigue life of weld seams and use the results to describe how tank age/service life affects the ability to withstand the various impact conditions over time.
 - 7.1.7 Engage with the UK fuel tanker industry to ensure the FE model(s) is(are) sufficiently representative of existing ADR-compliant designs, highlighting any issues that might occur with different tank designs.
 - 7.1.8 Contribute peer review time and expertise to the other fuel tanker research work (Parts A and B, whether they have a direct role in those or not). This will include attendance at regular research team meetings (expected to be at the DfT offices in Great Minster House (GMH), other Central London locations or elsewhere in the UK) and the reviewing of emerging findings and reports, throughout the duration of the WP5 research, to help ensure that the findings of Part C are used appropriately and that the overall proposals are well-founded in making sound use of FEM and ECA approaches. For costing purposes, respondents should assume attendance at a kick-off meeting and six (quarterly) research team meetings between March 2020 and July 2021, with two of those at GMH/Central London and the rest at locations to be decided elsewhere in the UK.

7.1.9 Bring together the findings from the FEM and ECA research into a report suitable for publication and to inform the other WP5 research projects.

8. OUTLINE OF OTHER WORK PACKAGE 5 RESEARCH (NOT REQUIRED AS PART OF THIS TENDER) – FOR INFORMATION ONLY

8.1 The purpose of the research will be to develop performance-based safety test procedures for fuel tankers which will provide manufacturers with an alternative to the current prescriptive design requirements. It is anticipated, if the current regulations are amended with alternative requirements that sit alongside the current requirements, that this will provide manufacturers with the freedom to bring more innovative and efficient designs to the market.

8.2 In addition to the research undertaken in Part C, WP5 will as a minimum include:

8.2.1 Part A (appointed provider Apollo Vehicle Safety Ltd):

8.2.1.1 Review and analysis of fuel tanker accident data and impact conditions, e.g. their frequency and how often rollovers, frontal, rear and side impacts lead to fuel spillage and/or tank rupturing, and in what specific circumstances.

8.2.1.2 Review of regulations impinging on the design of petroleum road fuel tankers.

8.2.2 Part B (appointed providers TRL Ltd and HSE):

8.2.2.1 Decide realistic impact scenarios for testing/modelling.

8.2.2.2 Model complete tankers, to provide a baseline for damage and failure mechanisms under test conditions, validated against the real-world accident damage evidence for, as a minimum, fully loaded tankers.

8.2.2.3 Model tanker sub-sections, to identify suitable modular tests which could provide results equivalent to those for complete tanker tests (based on damage and failure mechanisms).

8.2.2.4 Physical testing, to replicate realistic frontal, rear, side and rollover impacts and damage.

8.3 The outputs from Parts A, B and C of the research will be brought together by the DfT's appointed project manager in a summary report.

9. KEY MILESTONES

9.1 The milestones outlined below indicate the anticipated timescales for the delivery of the Part C research project.

Deliverable Number	Deliverable Description	Completion Date
WP005C/01	For each impact / test condition selected in Part B, completion of detailed FEM and ECA correlations with full scale impacts and predictions of performance in corresponding simplified physical tests in Part B.	1 month before each iteration of the corresponding simplified physical test in Part B
WP005C/02	For each impact / test condition selected in Part B, completion of validated FEM and ECA of corresponding simplified physical tests in Part B.	1 month after the final iteration of the corresponding simplified physical test in Part B
WP005C/03	Completion of draft report on findings of detailed FEM and ECA research, including text proposals for standards and regulations, a national technical code and / or CEN Technical Report as required at the time.	2 months after completion of WP005C/02
WP005C/04	Completion of final report on findings of detailed FEM and ECA research, including text proposals for standards and regulations, a national technical code and / or CEN Technical Report as required at the time.	1 month after completion of WP005C/03
WP005C/05	Peer review activities and contributions	From start to September 2021

10. AUTHORITY'S RESPONSIBILITIES

- 10.1 Not applicable – no specific responsibilities owned by the Authority which may either affect the Potential Provider's ability to deliver the requirement or their costs.

11. REPORTING

- 11.1 The successful provider shall submit a monthly report to the DfT's appointed project manager providing an update on the progress of the research project and the status of any issues identified. It is anticipated that this report shall be in the form of an email and include a single internal document, updated each month, summarising key points of the research and appropriate invoices raised.
- 11.2 Quarterly project meetings will be arranged at either the Contractor's site (if appropriate), at any other site(s) where the research may be conducted or at GMH. These will be arranged at mutually convenient times once the contract is in place.

12. CONTINUOUS IMPROVEMENT

- 12.1 Changes to the way in which the Services are to be delivered must be brought to the Authority's attention and agreed prior to any changes being implemented.

13. SUSTAINABILITY

- 13.1 Potential providers should be mindful in their response of the Department's priority to deliver safe, secure and sustainable travel. The response should detail any specific impacts on the sustainability of the transport of dangerous goods that are to be considered as part of this research.

14. QUALITY

- 14.1 The provider is required to be certified to operate an ISO 9001 accredited management system. Certification to other management systems such as health and safety and/or environment are also desirable and should be referenced in the response.

15. PRICE

- 15.1 The potential providers must include a cost profile showing the anticipated expenditure for each deliverable (set out in the milestones in section 9 of this document) in their proposal along with overall cost. A separate cost profile for the (optional) meetings attendance tasks set out in section 6.3 must also be provided.
- 15.2 The final invoice must be at least 10% of the full cost of the contract and prices must be inclusive of all expenses and exclusive of VAT. Any Prices shall remain firm until the end of the contract.
- 15.3 Travel and accommodation costs shall be booked by the supplier. The cost for all travel and accommodation will be included in the contract value and shall not exceed civil service staff rates without prior agreement from DfT's appointed project manager in the first instance, or the DfT project officer. Guidance on the applicable rates will be provided by the DfT's appointed project manager in the first instance, or the DfT project officer.
- 15.4 Prices are to be submitted via the Award portal. Access to this system can be obtained by emailing carys.keeble@df.gov.uk

16. STAFF AND CUSTOMER SERVICE

- 16.1 The provider's staff appointed for this work must be reputable and independent with demonstrable skills, knowledge and experience in the management and delivery of small-medium scale science and engineering research projects.
- 16.2 The successful provider's staff appointed for this work should have strong international presence in the standards making community and sufficient strength in depth to ensure appropriate representation at industry/peer review meetings.
- 16.3 The provider's staff will need to work closely with DGD officials and the DfT's appointed Project Manager to present the work as however may be appropriate to both the standards and legislative bodies. The skills and experience of those who are to undertake the work should be demonstrated by referencing publications, conference presentations, professional qualifications and descriptions of previous projects or case studies.
- 16.4 The Department considers the essential skills and experience required by the provider's staff are:
- 16.4.1 Proven experience in project management, particularly in science and engineering research projects, underpinned by experience in quality management.

- 16.4.2 Relevant experience of detailed FEM and ECA of structural integrity under dynamic impact conditions, vehicle safety research, policy development and project leadership, ideally related to heavy/dangerous goods tank-vehicles and the development of proposals/recommendations to amend international regulations/standards.
- 16.5 The Department considers the desirable skills and experience required by the provider's staff to be:
- 16.5.1 Experience in national and international cooperation (in particular on research projects, technical codes / reports and standards).
- 16.5.2 Technical expertise in petroleum road fuel tanker safety issues, ideally with relevant recent expertise in safety assessments, modelling and testing of tankers.
- 16.5.3 Experience of working with Government in a senior technical and research management role.
- 16.5.4 Experience of working collaboratively in/with research consortia and the co-ordination of individual work packages from diverse partner organisations.

17. SERVICE LEVELS AND PERFORMANCE

- 17.1 The Authority will measure the quality of the provider's delivery by:
- 17.1.1 Delivery of proposals, presentations and reports as detailed in the Milestones section, see section 9 above.

KPI/SLA	Service Area	KPI/SLA description	Target
#1	Delivery and quality requirements for deliverable WP005C/01	For each impact / test condition selected in Part B, completion of detailed FEM and ECA correlations with full scale impacts and predictions of performance in corresponding simplified physical tests in Part B.	All to be delivered by the dates specified in the milestones table in section 9.1 and to the quality requirements set out in section 7.1.
#2	Delivery and quality requirements for deliverable WP005C/02	For each impact / test condition selected in Part B, completion of validated FEM and ECA of corresponding simplified physical tests in Part B.	
#3	Delivery and quality requirements for deliverable WP005C/03	Completion of draft report on findings of detailed FEM and ECA research, including text proposals for standards and regulations, a national technical code and / or CEN Technical Report as required at the time.	
#4	Delivery and quality requirements for deliverable WP005C/04	Completion of final report on findings of detailed FEM and ECA research, including text proposals for standards and regulations, a national technical code and / or CEN Technical Report as required at the time.	
#5	Delivery and quality requirements for deliverable WP005C/05	Peer review activities and contributions	

18. SECURITY REQUIREMENTS

- 18.1 The work undertaken is at “official” level and therefore no specific security requirements are necessary.
- 18.2 “Official” level work is classified by the Department as including routine business operations and services, some of which could have damaging consequences if lost, stolen or published in the media, but are not subject to a heightened threat profile.

19. DATA PROTECTION

- 19.1 The supplier will be required to comply with all applicable requirements of the Data Protection Legislation (including the General Data Protection Regulation ((EU) 2016/679) (“GDPR”), the Law Enforcement Directive (Directive (EU) 2016/680), and all applicable Law about the processing of personal data and privacy).

20. INTELLECTUAL PROPERTY RIGHTS (IPR)

- 20.1 The Department for Transport will own all Intellectual Property Rights (IPR) for work generated under this contract and any contracts relating to research under the wider WP5 activity.

21. EVALUATION CRITERIA

- 21.1 See Appendix B Response Guidance

22. ARRANGEMENT FOR END OF CONTRACT

- 22.1 All documentation in relation to this contract, including emails, to be transferred to the DfT prior to the completion of this contract.

23. PAYMENT

- 23.1 Payment can only be made following satisfactory delivery of pre-agreed products and deliverables.
- 23.2 Before payment can be considered, each invoice must include a detailed breakdown of work completed and the associated costs.
- 23.3 To ensure prompt payment, a draft copy of invoice must be provided to the DfT’s appointed Project Manager in the first instance, or DfT Project Officer for clearance before the final invoice is submitted.
- 23.4 Once agreed with the DfT Project Manager or Project Officer, the final invoice shall be sent, within 10 days of the end of the month to the period which the claim relates, to: Shared Service Centre, Accounts Payable Team, Sandringham Park, Swansea Vale, Swansea, SA7 0EA.

24. LOCATION

- 24.1 It is anticipated that the successful provider’s technical lead will be based at a location that allows, in a single day, participation in and travel to and from inception, progress and closure meetings that will be held at GMH on the same day.

25. POINTS OF CONTACT

Procurement Contact	Name	Carys Keeble
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Project Officer	Name	David Adams
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All queries/ questions should be sent to the procurement contact