Service Description

Petroleum Road Fuel Tankers

Work Package 1 - Design, analysis and assessment: Review of design verification using finite element analysis in BS EN 13094

DfT Reference: PPRO 04/30/10

1. Introduction

The Department for Transport Dangerous Goods Division is looking to set up a contract for provision of various research activities to ensure that the international regulations and standards on petroleum road fuel tankers are designed to help minimise the risk of harm to people, property and the environment, and are proportionate and implemented in a way which helps to facilitate trade and economic growth.

This work package focuses on the design, analysis and assessment of petroleum road fuel tankers needed to secure improvements in the regulations and standards, particularly on state-of-the-art requirements for finite element analysis of tanker designs under rollover, side and rear impact conditions.

2. Background

Over the past few years the Department for Transport Dangerous Goods Division has successfully brought about the withdrawal from service of around 230 non-compliant tankers manufactured by GRW in South Africa. This 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”. More recently subsequent research was completed on the assessment of BS EN 13094 lap and partition joint designs.

This research focused specifically on end dish ruptures in rollover incidents and, at meetings of the relevant standards working group, helped to secure agreement on improvements to the tanker design and construction standard which would reduce the possibility of end dish ruptures in rollover incidents.

This and other things raised concerns about the use of finite element analysis for design verification elsewhere in the standard, and further work is now needed to establish state-of-the-art requirements for finite element analysis of other aspects of tanker designs under rollover, side and rear impact conditions to ensure that the standard is revised and adopted in regulations for July 2019.

3. Requirements

3.1. Objectives

The objectives of this work package is to review, with members of the relevant standards working group, the current requirements for design verification using finite element analysis in BS EN 13094 on the design and construction of metallic gravity discharge tanks, and to develop improved requirements and a detailed procedure for performing state-of-the-art finite element analysis of important aspects of tanker designs under normal service, rollover, side and rear impact conditions that are comparable to those recently developed to reduce the possibility of end dish ruptures in rollover incidents.

Once completed the requirements and procedure will, subject to the agreement of the relevant standards working group and the contracting parties to the European agreement on the carriage of dangerous goods by road, be included in the next revision of the standard and adopted in regulations for July 2019. Thus helping to minimise the risk of harm to people, property and the environment, and ensuring that requirements are proportionate and implemented in a way which helps to facilitate trade and economic growth.

3.2. Work Required

The current requirements for design verification using finite element analysis in BS EN 13094 Annex A.3 are to be reviewed, in isolation and with members of the relevant standards working group, and text revisions to the standard proposed as appropriate to improve the requirements and specify detailed procedures such that important aspects of tanker construction are designed in a manner consistent with state-of-the-art finite element analysis.

The work should consider the related standards BS EN 14025 and BS EN 13530-2 on the design and construction of metallic pressure tanks and cryogenic vessels respectively, the related standard BS EN 13445-3 on the design of unfired pressure vessels referenced therein, and address, amongst other things, including by way of demonstration, matters such as software selection, geometry, element type and mesh density, material properties, boundary and load conditions, analysis procedure and results analysis using relevant assessment methods, sensitivity to assumptions, and validation and reporting to verify the representivity of the model and document the analysis.

The text revisions to the standard are to be comparable in scope and detail to those proposed for the assessment of BS EN 13094 lap and partition joint designs, and included as appendices to the report on the work package.

4. Responsibilities

The contractor responsible for the work required would be guided by and work with the customer both in and outside discussions with members of the relevant standards working group, presenting the work as appropriate to both the standards and legislative bodies as may be necessary.

5. Skills/Experience

The work should be undertaken by a reputable independent body with skills, knowledge and experience in the assessment of tanker designs under normal service, rollover, side and rear impact conditions using state-of-the-art finite element analysis. The body should have a strong international presence in the standards making community and sufficient strength in depth to ensure representation at meetings of the relevant standards working group. The skills and experience of those who are to undertake the work may be demonstrated by referencing publications, conference presentations, professional qualifications and descriptions of previous projects or case studies.

5.1. Essential Skills

- Competence with solid mechanics, linear and advanced nonlinear finite element analysis (including contact, nonlinear material properties, and damage modelling) and hand calculations for pressure vessels, pressure equipment, and thin-wall components in industrial applications.
- Proficient in the use of Computer Aided Design (CAD) software, parametric modelling, and commercial finite element analysis software.
- Understanding of standard design, structural strength and fatigue calculations for tankers and pressure equipment in the transport industry.

5.2. Desirable Skills

- Experience in deformation, mechanical properties and damage mechanisms of metallic materials, in particular of aluminium alloys.
- Experience in project participation, national and international cooperation (in particular on codes and standards) and quality management.
- Experience of working in a technical capacity with the Department for Transport and / or an agency such as Highways England.

6. Deliverables

Deliverable Number	Deliverable Description	Completion Date
WP001/01	Presentation to be given in late 11/2016 to domestic stakeholders responsible for design and construction.	11/11/2016
WP001/02	Proposed text revisions to BS EN 13094 to improve the current requirements for design verification using finite element analysis in Annex A.3.	02/12/2016
WP001/03	Proposed text revisions to BS EN 13094 for the numerical assessment of important aspects of tanker designs under normal service, rollover, side and rear impact conditions.	02/12/2016
WP001/04	Presentation to be given in 12/2016 or 01/2017 and / or 03/2017 to the contracting parties of the European agreement on the carriage of dangerous goods by road.	02/12/2016

WP001/05	Draft final report demonstrating and including as appendices the final proposed text revisions to BS EN 13094 to improve the current requirements for design verification using finite element analysis in Annex A.3 and for the numerical assessment of important aspects of tanker designs under normal service, rollover, side and rear impact conditions.	01/11/2017
WP001/06	Presentation to be given in late 11/2017 to domestic stakeholders responsible for design and construction.	10/11/2017
WP001/07	Final report demonstrating and including as appendices the final proposed text revisions to BS EN 13094 to improve the current requirements for design verification using finite element analysis in Annex A.3 and for the numerical assessment of important aspects of tanker designs under normal service, rollover, side and rear impact conditions.	01/12/2017
WP001/08	Presentation to be given in 12/2017 or 01/2018 and / or 03/2018 to the contracting parties of the European agreement on the carriage of dangerous goods by road.	01/12/2017

Please include a separate price breakdown for each of the above deliverables in your proposal along with an overall cost.

7. Additional information

The contractor responsible for the work required will need to participate in meetings with domestic stakeholders responsible for design and construction (normally held in a mutually convenient location in the UK), the relevant standards working group and the sub group on finite element analysis (normally held in London or by exception elsewhere at a mutually convenient location for the participants), 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 carriage of dangerous goods by road), and the UN ECE Joint Meeting of the RID Committee of Experts and the Working Party on the Transport of Dangerous Goods, and the Working Group on tanks (normally held in Geneva in September and Bern in March).

The contractor will need to be able to respond at short notice to requests to consider and act on suggestions to revise the deliverables, particularly in the run up to deadlines and the meetings as set out above.

During the course of the work it may be necessary for the contractor to undertake peer review with experts from academia and industry in the UK not involved in the meetings set out above.

8. Location

The contractor responsible for the work needs to be based in a location such that travel to and from and participation in inception, progress and closure

meetings to be held at Great Minster House, London or at the base of the contractor can all take place on the same day.

9. Timescales

Start date: Monday 03 October 2016

Duration: 18 months

10. Evaluation Criteria

Work Package Evaluation Criteria –

Primary Criteria	Sub-criteria	Score	Weighting	Weighted Score
`Resources and capabilities	Supplier's prior performance on this type of work.		3	
	Suitability of key personnel.		3	
	Capability and expertise of additional staff/resource.		3	
	Appropriate allocation of resource.		3	
Technical solution proposed and competence	Demonstrates understanding of the objectives, deliverables and what DfT is trying to achieve.		2	
	Robustness of the proposal and methodology (how requirements will be achieved).		2	
	Creative and innovative thinking.		2	
	Proposed project management and quality control systems.		2	
Suitability of proposed processes	Identification and management of risks.		1	
Subtotal				
Total	Total Mark (Subtotal x 100/210)			

The assessment panel will use the marking system as shown below, to award marks for approach or evidence, as relevant to the sub-criteria in the previous table.

Score	**Reason**	**Mark**
Weak	The proposed approach fails to demonstrate an adequate understanding of the project objectives and fails to address adequately the risk management issues. There is little evidence that the proposed approach has been influenced by experience on other projects.	1-4
Acceptable	The proposed approach demonstrates an adequate understanding of the project objectives; it	

	addresses the success factors and risk management issues to an acceptable standard. There is an adequate level of evidence that the proposed approach has been developed as a result of successful experience on other projects.	5-7
Good	The proposed approach demonstrates a good understanding of the project objectives; it addresses fully the success factors and risk management issues and provides for delivering continuous improvement over the life of the framework. There is substantial evidence that the proposed approach has been developed from other projects using formal continual improvement processes.	8-9
Excellent	The proposed approach has been tailored specifically to deliver the project objectives, and deals comprehensively with the risks to maximising performance against Key Performance Indicators and to delivering continuous improvement. There is substantial evidence that the approach has been developed using continual improvement processes, which are routinely used to develop approaches and deliver the objectives successfully on all projects.	10

The proposal with the highest mark will be given a score of 100. The score of other competing suppliers will be calculated by deducting from 100 one point for each full percentage point by which their mark is below the highest mark. The minimum requirement for this Work Package is to reach a threshold of 80. A submission that has failed to achieve the minimum quality requirements may not be considered further in the assessment.

The lowest priced tender will be given a score of 100. The score of other competing suppliers will be calculated by deducting from 100 one point for each full percentage point by which their price is above the lowest price. The overall quality score and the finance score will be combined in the ratio 80:20 applied to the quality and financial scores respectively.

11. Contact Information

Role	Location	Phone
Project Sponsor: Roh Hathlia	Dangerous Goods Division, Great Minster House, London	020 7944 2758
Project Manager: Steve Gillingham	Dangerous Goods Division, Great Minster House, London	07799 868841
DfT Business Partner: Tony Moss	Group Commercial Services, Zone D6, Ashdown House, Hastings	0207 944 8422