RCloud Tasking Form – Part B: Statement of Requirement (SoR)

Title of Requirement	**Material Characterisation of Aircraft Structures**
Requisition No.	**1000163612**
SoR Version	**1.0**

1.	**Statement of Requirements**
1.1	**Summary and Background Information**
	Taxonomy references: *Engineering Technology and Design, Mechanical Engineering. Engineering Technology and Design, Test and Evaluation Capability.* In light of the REDACTED UNDER FOI EXEMPTION from REDACTED UNDER FOI EXEMPTION, the Department for Transport (DfT) requires the capability to effectively assess the REDACTED UNDER FOI EXEMPTION Historically the Authority/Dstl has conducted large work packages investigating the REDACTED UNDER FOI EXEMPTION, undertaking physical testing and using the results to develop computational finite element (FE) models to inform this requirement. The latest aircraft construction techniques now include the use of Carbon Fibre Reinforced Plastic (CFRP) materials. REDACTED UNDER FOI EXEMPTION. Physical testing has already been conducted on surrogate aircraft panels constructed from CFRP, REDACTED UNDER FOI EXEMPTION. FE models of these panels have been created, however the representation of the material CFRP, bonded connections and riveted connections are currently simplified. These need to be improved REDACTED UNDER FOI EXEMPTION ***Objective of the Research:*** Extensive characterisation testing is required to provide appropriate parameters for populating FE models of the surrogate panels. In line with the panel construction, the Contractor is asked to plan and conduct a series of appropriate characterisation tests, on CFRP material coupons, adhesive bonded connections and riveted connections. And to build, verify and validate FE models of these characterisation tests. All modelling shall be undertaken using the LS-DYNA FE code. On completion of these tasks, the resulting parameters will be incorporated within the surrogate

	panels by the Authority/Dstl (mentioned above).
1.2	**Requirement**
	This tasking will be for an initial requirement (Work Package 1), with subsequent requirements as Contract options (Work Packages 2-5). Each option will focus on a single element that needs to be tested and developed. The initial requirement will be let with the Contract, with the further options being implemented if/as required as the project progresses. **Intellectual Property Rights** DEFCON 705 shall apply to all of the deliverables against this Contract. **Marking of Information & Deliverables:** Bidders should note that the deliverables associated with this task may be distributed to MOD and OGD stakeholders in the future, therefore Dstl seeks to secure Full User Rights in the deliverables. **Work Package One** Material characterisation testing of coupons representative of a REDACTED UNDER FOI EXEMPTION (TORAY T800/3900-2 UNI or similar aerospace CFRP). The Contractor shall undertake material testing of CFRP material, to obtain the required information (i.e fracture toughness) in order to develop/generate LS-DYNA materials models that are able to replicate the same response (i.e. crack propagation). Characterisation is to include both physical and numerical testing of suitable specimens and subsequent material model development. **The Contractor shall follow steps 1 to 6, as detailed below:** 1. Develop an appropriate test plan for the characterisation of each item (incorporating both experimental and modelling aspects) 2. Build, verify and simulate computational models of tests, within LS-DYNA, ahead of physical testing 3. Generate test coupons and fixtures for physical testing 4. Conduct tests to establish the response 5. Validate/improve computational LS-DYNA models of tests 6. Supply generated test data, characterisation parameters and validated FE models. **Delivery timescales** • The Contractor shall set up a meeting within 1 month of contract placement to enable the Authority to monitor progress and confirm that the proposed outputs will fall in line with expectation. A brief presentation is to be given by the Contractor to the Authority to provide an overview of the planned work. This meeting will be held at the Contractor's premises. • Monthly progress updates are required from the Contractor to the Authority via an e-mail, after the initial meeting.

	• The Contractor shall undertake material characterisation testing within 12 weeks of contract placement. • The Contractor shall deliver a technical report within 16 weeks of contract placement. The Contractor shall arrange an "end of project" wash-up meeting to cover the findings of the technical report. They shall present and discuss the technical report with the Authority.
1.3	**Options or follow on work**
	CONTRACT OPTIONS The following requirements are potential options for further work packages that may be implemented upon evaluation of the success of prior tasks within the Contract; these are to be completed in order of priority and dependent on time and funding available. **The Contractor shall not undertake any work on any of the options unless formally advised to do so by Dstl Commercial Services.** **The following options/work packages shall be priced separately as part of the Contractor's proposal.** The approximate date that each work package may be implemented is as follows: Work Package 2 – October 2021 Work Package 3 – April 2022 Work Package 4 - July 2022 Work Package 5 – October 2022 These dates will be reviewed by the Authority/Dstl and the Contractor updated with indicative dates as the project progresses. The Authority shall advise the Contractor via e-mail, if each option is to be exercised within two weeks prior to the stated indicative dates detailed above. The Authority will also provide confirmation of the dates within a 2 week notice period prior to exercising any of the options on the Contract. **Work Package Two - Option** Optimisations of an appropriate LS-DYNA material card for TORAY T800/3900-2 UNI material or similar aerospace CFRP. The Contractor shall undertake LS-DYNA material card optimisation based on Work Package One testing, manufacturer's datasheets and/or other data available to the Contractor. **The Contractor shall follow steps 5 to 6, as detailed below:** 5. Validate/improve computational LS-DYNA models of tests 6. Supply generated test data, characterisation parameters and validated FE models. **Delivery timescales**

- The Contractor shall set up a meeting within 1 month of contract placement of work package two to enable the Authority/Dstl to monitor progress and confirm that the proposed outputs will fall in line with expectation. A brief presentation is to be given by the Contractor to provide an overview of the planned work. This meeting will be held at the Contractor's premises.
- Monthly progress updates are required by the Authority/Dstl via an e-mail, after the initial meeting.
- Undertake material optimisation within 8 weeks of commencement
- The Contractor shall deliver a technical report within 12 weeks of commencement
- An "end of work package" wash-up meeting is required to present and discuss the findings of the technical report

Work Package Three - Option

Characterisation of the adhesive used on REDACTED UNDER FOI EXEMPTION to adhere skin materials to stringer materials (or similar aerospace adhesive).

The Contractor shall undertake physical testing of the adhesive material (such as DCB, ENF and mixed mode test coupons), to obtain the required information in order to develop/generate LS-DYNA materials models/modelling approaches (such as cohesive elements, tie-break contact etc.) that are able to replicate the same response.

Characterisation is to include both physical and numerical testing of suitable specimens and subsequent material model development.

The Contractor shall follow steps 1 to 6 as detailed below:

1. Develop an appropriate test plan for the characterisation of each item (incorporating both experimental and modelling aspects)
2. Build, verify and simulate computational models of tests, within LS-DYNA, ahead of physical testing
3. Generate test coupons and fixtures for physical testing
4. Conduct tests to establish the response
5. Validate/improve computational LS-DYNA models of tests
6. Supply generated test data, characterisation parameters and validated FE models.

Delivery timescales

- The Contractor shall set up a meeting within 1 month of contract placement of work package three to enable the Authority/Dstl to monitor progress and confirm that the proposed outputs will fall in line with expectation. A brief presentation is to be given to provide an overview of the planned work. This meeting will be held at the contractor's premises.
- Monthly progress updates shall be provided by the Contractor via an e-mail, after the initial meeting.
- Undertake characterisation testing within 12 weeks of commencement
- Deliver technical report within 16 weeks of commencement
- An "end of work package" wash-up meeting is required to present and discuss the findings of the technical report

Work Package Four - Option

Characterisation of rivets/riveted connections used on REDACTED UNDER FOI EXEMPTION (or similar aerospace rivets).

The Contractor is to undertake physical testing of rivets/riveted connections to obtain the required information in order to develop/generate LS-DYNA materials models/modelling approaches (such as constraint nodes beam (spot-weld) or contact constraints etc.) that are able to replicate the same response.

Characterisation is to include both physical and numerical testing of suitable specimens and subsequent development of a numerical modelling approach.

The Contractor shall follow steps 1 to 6 as detailed below:

1. Develop an appropriate test plan for the characterisation of each item (incorporating both experimental and modelling aspects)
2. Build, verify and simulate computational models of tests, within LS-DYNA, ahead of physical testing
3. Generate test coupons and fixtures for physical testing
4. Conduct tests to establish the response
5. Validate/improve computational LS-DYNA models of tests
6. Supply generated test data, characterisation parameters and validated FE models.

Delivery timescales

- The Contractor shall set up a meeting within 1 month of contract placement of work package four to enable the Authority to monitor progress and confirm that the proposed outputs will fall in line with expectation. A brief presentation is to be given to by the Contractor to provide the Authority/Dstl with an overview of the planned work. This meeting will be held at the Contractor's premises.
- Monthly progress updates are required via an e-mail, after the initial meeting.
- Undertake characterisation testing within 12 weeks of commencement
- Deliver technical report within 16 weeks of commencement
- An "end of work package" wash-up meeting is required to present and discuss the findings of the technical report

Work Package Five - Option

Subcomponent characterisation of items supplied by the Authority/Dstl. Characterisation is to include both physical and numerical testing of sections of surrogate aircraft panels that will be supplied by the Authority/Dstl.

These sections combine all aspects developed in Work Packages 1-4, including skin, stringers and frame parts. Constructed from TORAY T800/3900-2 UNI CFRP, rivets and adhesives bonds.

The Contractor shall undertake physical testing of surrogate sections to obtain the required information in order to develop/generate LS-DYNA materials models that are able to replicate the same response.

	Testing shall include tensile, compressive and/or bending loads, which will allow for global validation of the sections/system which include the materials, rivets and adhesives, already characterised. **The Contractor shall follow steps 1 to 6 as detailed below:** 1. Develop an appropriate test plan for the characterisation of each item (incorporating both experimental and modelling aspects) 2. Build, verify and simulate computational models of tests, within LS-DYNA, ahead of physical testing 3. Generate test coupons and fixtures for physical testing 4. Conduct tests to establish the response 5. Validate/improve computational LS-DYNA models of tests 6. Supply generated test data, characterisation parameters and validated FE models. **Delivery timescales** - The Contractor shall set up a meeting within 1 month of contract placement of work package five to enable the Authority to monitor progress and confirm that the proposed outputs will fall in line with expectation. A brief presentation is to be given by the Contractor to provide an overview of the planned work. This meeting will be held at the Contractor's premises. - Monthly progress updates are required via an e-mail, after the initial meeting. - The Contractor shall undertake material characterisation testing within 12 weeks of commencement - Deliver technical report within 16 weeks of commencement - An "end of work package" wash-up meeting is required to present and discuss the findings of the technical report **The following are mandatory requirements for each work package;** • Tests to be carried out at the Contractor's premises. • Calibration certificates, for all physical lab test equipment, shall be provided to ensure data collected is accurate and suitable for model validation. • It is required that the Contractor provides details of their expertise in numerical material model development and the use of the LS-DYNA FE code. • It is required that a range of properties are obtained in order to populate material model templates, used within the LS-DYNA FE code. It is required that a data pack of all generated test data (raw and/or processed) and all developed/generated Finite Element models must also be supplied to the Authority/Dstl by the Contractor.
1.4	**Contract Management Activities**
	<u>Acceptance Criteria</u> The final technical report shall include, but not limited to details of all testing undertaken; including documentation of setup and any standards followed; the generated data shall be presented in a clear and concise manner so that it can be used to populate model templates; information surrounding the build, verification and validation computational models.

	The report shall be provided by the Contractor in the form of a written document (MS Word) and be sent to the Technical POCs of the Contract (REDACTED UNDER FOI EXEMPTION and REDACTED UNDER FOI EXEMPTION) A data pack of all generated test data (raw and/or processed) and all developed Finite Element models generated as part of the validation exercises must also be supplied along with the written report. The Authority/Dstl will be responsible for acceptance of the deliverable/s. The outputs will be checked by the Authority for consistency and quality before acceptance. Acceptance will take place at Dstl Porton Down. Acceptance will be determined by a formal review of the delivered document/reports by the Authority. Acceptance will take place within 30 days of receipt of the deliverable by the Authority/upon completion of the Contract by the Contractor. The Contractor will be advised if and when the deliverable is acceptable. If any deliverables are not accepted, the Contractor shall be required to take remedial action to the satisfaction of the Authority, at no additional cost to the Authority.
1.5	**Health & Safety, Environmental, Social, Ethical, Regulatory or Legislative aspects of the requirement**
	For packaging and sending GFA, the Authority shall take the relevant steps to minimise risks related to COVID-19, as detailed in the Dstl COVID-19 Risk Assessment, dated 16/06/2020. REDACTED UNDER FOI EXEMPTION

1.6	Deliverables & Intellectual Property Rights (IPR)					
Ref.	**Title**	**Due by**	**Format**	**Expected classification (subject to change)**	**What information is required in the deliverable**	**IPR Condition**
1	Initial Requirement - Final Report	Within 16 weeks of contract placement	MS Word document (.docx)	OFFICIAL	The final technical report shall include, but not limited to details of all testing undertaken; including documentation of setup and any standards followed; the generated data shall be presented in a clear and concise manner so that it can be used to populate model templates; information surrounding the build, verification and validation computational models. A data pack of all generated test data (raw and/or processed) and all developed Finite Element models generated as part of the validation exercises must also be supplied along with the written report.	*Default RCloud Agreement Terms and Conditions shall apply*
						Default RCloud Agreement Terms and Conditions shall apply

						Default RCloud Agreement Terms and Conditions shall apply
						Default RCloud Agreement Terms and Conditions shall apply
						Default RCloud Agreement Terms and Conditions shall apply

.

1.7	**Deliverable Acceptance Criteria**
	All Reports included as Deliverables under the Contract e.g. Progress and/or Final Reports etc. must comply with the which defines the requirements for the presentation, format and production of scientific and technical reports prepared for MoD. Interim or Progress Reports: The report should detail, document, and summarise the results of work done during the period covered and shall be in sufficient detail to comprehensively explain the results achieved; substantive performance; a description of current substantive performance and any problems encountered and/or which may exist along with proposed corrective action. An explanation of any difference between planned progress and actual progress, why the differences have occurred, and if behind planned progress what corrective steps are planned. Final Reports: shall describe the entire work performed under the Contract in sufficient detail to explain comprehensively the work undertaken and results achieved including all relevant technical details of any hardware, software, process or system developed there under. The technical detail shall be sufficient to permit independent reproduction of any such process or system. All Reports shall be free from spelling and grammatical errors and shall be set out in accordance with the Statement Of Requirement (1) above. Failure to comply with the above may result in the Authority rejecting the deliverables and requesting re-work before final acceptance, in accordance with DEFCON 524 Rejection. *Standard Framework T&C's conditions apply – please note, inclusion of DEFCON 800 series.* *Open Book Accounting.*

2	**Evaluation Criteria**
2.1	Method Explanation
	The response from the Contractor will be evaluated by the Senior Technical Lead to ensure the Statement of Requirements have been fully considered and met. The Authority will use an evaluation model consisting of three criteria, weighted as follows; Technical: 80% Commercial: Pass/Fail Cost: 20% A total technical score will be calculated using a weighted sum of marks awarded for each of the questions. A pro-rata score is then calculated. The highest scoring technically compliant solution will be allocated the full 80% in the technical assessment with other compliant solutions being allocated a pro-rate score based on their overall technical marks.

Score	**Definition**

5	Exceeds the Authority's requirement
4	Fully meets the Authority's requirement
3	Adequately meets the Authority's requirement
2	Falls short of the Authority's requirements in a minor respect
1	Falls short of the Authority's requirements in a major respect, or tenderer did not adequately explain their response or did not provide adequate evidence of claimed capability
0	Tenderer did not respond to the question or tenderer's response indicated that their capabilities wholly failed to meet the Authority's requirements.

The highest scoring, technically compliant, bid shall be awarded the maximum percentage score (80); the remaining submitted bids shall be awarded points based on deviation from the maximum score, i.e. Tenderers Score/Highest Technical Score x Available Points.

Example – The winning bidder scores 70 marks

Tenderer	Score (Note: figures quoted are for example purposes only)	Calculation	Score Awarded
1	70	70/70 x 80	80
2	60	60/70 x 80	69
3	40	40/70 x 80	46

2.2 Technical Evaluation Criteria

ID	Criteria	Score	Weighting
1	The proposal provides strong evidence that the bidder has the expertise and deep technical knowledge in the relevant areas. Historical reports, papers or similar, demonstrating this, that have been generated by the supplier must be attached to their bid, for scrutiny by Dstl as part of this process.	0-5	5

	2	The bidder has provided evidence that the suggested testing methodology and scientific principles will provide the required information. Historical reports, papers or similar, demonstrating this, that have been generated by the supplier must be attached to their bid, for scrutiny by Dstl as part of this process.	0-5	4
	3	The bidder has provided a feasible and detailed work plan of activities, with risks and mitigations clearly identified. A project plan in the form of a Gantt chart or similar is expected.	0-5	4
	4	The bidder has provided details of their expertise in numerical material model development and the use of the LS-DYNA FE code. Historical reports, papers or similar, demonstrating this, that have been generated by the supplier must be attached to their bid, for scrutiny by Dstl as part of this process.	0-5	5
	5	The bidder has provided a detailed plan of how they intend to supply information surrounding the damage and failure of the test samples, demonstrating their understanding and knowledge of this complex phenomenon. Historical reports, papers or similar, demonstrating this knowledge, that have been generated by the supplier must be attached to their bid, for scrutiny by Dstl as part of this process.	0-5	5
2.3	Commercial Evaluation Criteria			
	Compliance to R-Cloud v4 terms and conditions and agreed rates.			