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Statement of Work for the Updated Reconnaissance Pod

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Record of Changes

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Contents

1 Introduction

1.1 Purpose

This document constitutes the statement of work used for one of the cases in the Systems Engineering course taught at Aarhus University, Department of Engineering.

1.2 Scope

The scope of this document is the statement of work to be carried out in fulfillment of the case study during the Systems Engineering course.

1.3 Application

This document applies to the Systems Engineering course taught as Aarhus University.

2 References

Ref.	Doc. No.	Title
[TRD]	1034832-DC	Technical Requirements Document for the URP

3 Definitions

Term	Definition
CSCI	Computer Software Configuration Item
HWCI	Hardware Configuration Item
LCC	Life Cycle Cost
MRP	Modular Reconnaissance Pod
NATO	North Atlantic Treaty Organization
NDI	Non-Development Item
OTS	Off The Shelf
RDAF	Royal Danish Airforce
SCA	Safety Compliance Assessment
SEMP	Systems Engineering Management Plan
SOW	Statement of Work
STANAG	Standardization Agreements
URP	Updated Reconnaissance Pod

4 Scope of Work

This SOW contains requirements for the system design and qualification efforts of the Updated Reconnaissance Pod (URP).

The work comprises the design and qualification efforts undertaken by the Contractor, up to and including successful completion and acceptance of the system design.

During these efforts, the Contractor shall design and qualify the URP to demonstrate the achievement of the contractual specifications on a representative system configuration as specified in this contract. It is assumed that the qualification effort is carried out on a conceptual model of the URP design.

The Contractor shall develop and implement the management and engineering processes, principles and procedures identified within this Statement of Work.

4.1 General

Terma is tasked with designing, developing, qualifying and producing an updated reconnaissance pod to the Royal Danish Airforce (RDAF). To meet this objective, the design of the updated reconnaissance pod is subcontracted to the Contractor, who is responsible for providing Terma with complete design documentation including a model of the updated reconnaissance pod (URP). The URP is intended to

- provide surveillance capabilities to the RDAF in the form of high-altitude imaging
- replace the current Modular Reconnaissance Pod (MRP)

In addition, the design and an associated model is intended to

- provide the mechanical, electrical and thermal design documentation of the updated reconnaissance pod
- be able to verify the design and the characteristics of the updated reconnaissance pod prior to production

4.2 Standards for Interpretation of SOW

Throughout this Statement of Work (SOW), the following applies:

1. Where referenced standards, specifications, etc., refer to the "Government", this shall be interpreted to mean Terma.
2. The word SHALL in the text expresses a mandatory task of the SOW. Departure from such a task is not permissible without formal written agreement between the Contractor and Terma.
3. When days, months or years are referenced in this SOW, they shall mean calendar time (not counted as business days).
4. Whenever requirements are stated herein to "include" a group of items, parameters, or other considerations, "include" shall be construed to mean those items, parameters, or other considerations specified.
5. Whenever reference is made to a section, task, or paragraph, the reference shall be construed to include the subordinate and referenced paragraphs unless otherwise specified.
6. The order of the SOW requirements is not intended to specify the order in which they must be carried out unless explicitly stated. The SOW defines the activities the Contractor's process should cover, i.e., the Contractor's process description and plans should include where and when these occur.

5 Requirements

5.1 Risk Management

The Contractor shall implement a Risk Management process to include risk management planning, identification, analysis, responses and monitoring and control. The Contractor shall provide within the process structured procedures to ensure the identification, assessment, prioritization and mitigation of risks. It shall describe the control mechanism regarding the implementation of mitigating action and the continual monitoring and follow-up activities.

5.2 Technical Management

The Contractor shall design a URP that satisfies the requirements of the Technical Requirements Document (TRD).

The Contractor shall maximize the use of Off-the-Shelf (OTS) hardware and software in the design of the URP to reduce developmental costs.

The Contractor is to be expected to coordinate with their sub-contractors to ensure that the appropriate national and local laws, regulations are identified and that, where necessary contractual mechanisms are in place to ensure compliance.

5.2.1 Standards

The TRD specifies NATO Standardization Agreements (STANAGs) publications, Mil Standards, Mil Handbooks, and other Commercial Standards, where appropriate. Where STANAGs and other NATO publications are not specified, the Contractor shall base the system design on military/commercial/industrial/international standards (i.e., standards widely used and supported by a significant number of manufacturers).

5.2.2 System Engineering Planning

The Contractor shall develop and employ a proven system engineering and development methodology. The Contractor shall provide this methodology in a System Engineering Management Plan (SEMP), indicating overall systems engineering approach, milestone reviews, time schedule, dependencies etc.

5.2.3 Contractor's System Requirements Specification

The Contractor shall employ the systems engineering process per ISO/IEC 15288:2008 in accordance with the SEMP.

The Contractor shall document and provide requirements traceability and design for each System, Subsystem, Hardware Configuration Item and Computer Software Configuration Item (HWCI/CSCI).

5.2.4 Design Principles

In developing the system architecture to satisfy the TRD, the Contractor shall consider the following design principles:

1. Maximum use of NDI for both Hardware and Software.
2. Minimize new development.
3. Selection of equipment to meet the design functionality with minimal impact to the overall modular open systems architecture.
4. Minimize crew workload and/or number of operators required via automation or other methods.
5. A modular design and integration which precludes long term dependence on closed or proprietary interface standards, technologies, products, or architectures.
6. A design which provides for growth and open interface standards to allow future reconfiguration and addition of new capabilities without large-scale redesign of the system.

5.2.5 Life-Cycle Cost

The Contractor shall estimate the URP Life Cycle Cost (LCC). The LCC shall reflect the negotiated procurement price and any subsequent changes post contract award.

5.2.6 Interfaces Control Document

The Contractor shall provide Terma with an Interfaces Control Document describing the external interfaces of the URP that are used for interoperability purposes.

5.3 Verification

The scope of this SOW chapter is to specify the contractual requirements for the Qualification, Verification and Validation effort.

5.3.1 Introduction

This section introduces some terms used in the verification section. It also establishes the phases of the verification effort, and approaches for testing. Throughout this section the term "develop" shall be interpreted to include new development, modification, re-engineering, or other activities or combination of activities resulting in end items and enabling products.

5.3.2 Formal Verification

The Contractor is to verify that the design satisfies the TRD requirements. The term verify encompasses "Inspection", "Demonstration", "Testing", and "Analysis". The Contractor is to document results of the verification effort in Verification Reports.

5.3.3 Certificates of Conformity

Certificates of conformity for deliverable equipment shall be provided as part of the delivery and constitute partial or complete fulfilment of the requirements to the extent covered by the certificate.

5.4 Safety

5.4.1 Objective

Terma's objective is to acquire the URP which is to be used throughout its life cycle in compliance with progressive principles of safety, health protection, handling with hazardous materials and the environment protection. The Contractor shall design a safely operated, supported and maintained URP, protecting the operators, technicians, people on the ground and their environment, and also the system itself.

5.4.2 Safety Compliance Assessment (SCA)

The Contractor shall perform the Safety Compliance Assessment. The Contractor shall use definitions and classifications of hazards as specified in MIL-STD 882, Table I and II.

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Contents

1 Introduction

1.1 Purpose

This document constitutes the technical requirements document used for one of the cases in the Systems Engineering course taught at Aarhus University, Department of Engineering.

1.2 Scope

The scope of this document is the requirements to meet in fulfillment of the case study during the Systems Engineering course.

1.3 Application

This document applies to the Systems Engineering course taught as Aarhus University.

2 References

Ref.	Doc. No.	Title
[SOW]	1034832-SO	Statement of Work for the Updated Reconnaissance Pod

3 Definitions

Term	Definition
AC	Alternating Current
ft	feet
kft	kilo feet – i.e. 1000 feet
RDAF	Royal Danish Airforce

4 Technical Requirements

ID	Technical Requirements	Req. Type	Verif. Method
SLR-73	1 Information	E	
SLR-95	1.1 Requirement Types	E	
SLR-96	1.1.1 Mandatory	E	
SLR-97	Mandatory requirements are pass/fail criteria. The verb "shall" and the requirement type M are used to denote mandatory requirements.	E	
SLR-98	1.1.2 Desirable	E	
SLR-99	Desirable requirements are not pass/fail criteria, but will enhance the core performance if included. The verb "should" and requirement type D are used to denote desirable requirements.	E	
SLR-100	1.1.3 Optional	E	
SLR-101	Optional requirements are not pass/fail criteria, but will add to the capabilities and/or performance of the system. The verb "may" and requirement type O are used to denote optional approaches.	E	
SLR-139	1.1.4 Explanatory	E	

ID	Technical Requirements	Req. Type	Verif. Method
SLR-140	Descriptive text of an explanatory nature contains no requirements and is marked with requirement type E.	E	
SLR-102	1.2 Verification Methods	E	
SLR-103	For each requirement in this specification, the primary means for verification are indicated as:	E	
SLR-108	1.2.1 Inspection	E	
SLR-109	Inspection is the visual examination of an item (hardware and software) and associated descriptive documentation. Verification is based on the human senses (sight, touch) or other means that use simple measurement and handling methods. No stimulus is necessary. Passive resources such as meter rule, gauge may be used. Requirements to which verification by inspection applies are marked with verification method I.	E	
SLR-111	1.2.2 Analysis	E	
SLR-112	Analysis is a qualification method that utilizes established technical or mathematical models, algorithms, simulations or other scientific principles and procedures to provide evidence that stated requirements are met. Requirements to which verification by these means apply are marked with verification method A.	E	
SLR-116	1.2.3 Similarity	E	
SLR-117	Analysis by Similarity uses reference to previous test data or published performance specification values, and is applicable for requirements which have been verified for similar equipment, systems or software. Requirements to which verification by these means apply are marked with verification method S.	E	
SLR-126	1.2.4 Demonstration	E	
SLR-127	Demonstration is the operation of the system, or a part of the system, under controlled and specified conditions, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis. Requirements to which verification by demonstration applies are marked with verification method D.	E	

ID	Technical Requirements	Req. Type	Verif. Method
SLR-131	1.2.5 Test	E	
SLR-132	Test is the operation of the system, or a part of the system, under controlled and specified conditions, using instrumentation or other special test equipment to collect data for later analysis. This verification method usually requires recorded results to verify that the requirements have been satisfied. Requirements to which verification by test applies are marked with verification method T.	E	
SLR-141	2 Requirements	E	
SLR-142	2.1 Flight	E	
SLR-143	The pod shall be center-mountable on the Royal Danish Air Force (RDAF) F-16 AM/BM fighter aircrafts in version M6.5.	M	A
SLR-144	The pod shall have a mass less than 700 pounds in total.	M	A
SLR-146	The pod shall have a geometric cross-section of 0.40 m^2 or less as seen from the front.	M	A
SLR-159	The pod should have a geometric cross-section of 0.25 m^2 or less as seen from the front.	D	
SLR-145	2.2 Imaging	E	
SLR-147	The pod shall be equipped with an electro-optical sensor.	M	A
SLR-148	The pod shall be able to acquire images of targets and areas on the ground.	M	A
SLR-149	The pod shall be able to store up to 10,000 images on-board.	M	A
SLR-160	The pod should be able to store up to 100,000 images on-board.	D	
SLR-183	The pod shall be able to acquire images with a footprint of 600x600 m and a ground resolution distance of less than 10 cm while flying at an altitude of 10 kft at a ground speed of 400 knots.	M	A
SLR-150	The pod shall be equipped with at least one of the following sensors: - XTS-365-18 - CA-265-12 - CAQ-455-18	M	A

ID	Technical Requirements	Req. Type	Verif. Method
SLR-168	The pod shall include relevant flight information as metadata in the imagery.	M	A
SLR-152	The pod shall be able to acquire images of an area with a size 6 km wide and 60 km long in a single flyover at an altitude of 15 kft at a ground speed of 350 knots without image overlap.	M	A
SLR-182	The pod should be able to acquire images of an area with a size 6 km wide and 60 km long in a single flyover at an altitude of 15 kft at a ground speed of 350 knots with an image overlap of 55% in the line of flight.	D	A
SLR-158	The pod shall be able to georeference the imagery with an absolute precision better than 1 m (1 standard deviation).	M	A
SLR-164	The pod shall support air-to-air mode, where forward-motion-compensation is disabled.	M	A
SLR-165	The pod shall be able to adjust the image acquisition to account for the terrain height, given a digital elevation model of the Earth.	M	A
SLR-175	2.3 Interfaces	E	
SLR-176	The pod shall run on the 115V 400Hz AC power available from the aircraft.	M	A
SLR-177	The pod shall have a power consumption less than 6700 Watt.	M	A
SLR-167	The pod shall obtain live flight information from the aircraft via its MIL-STD 1553 bus.	M	A
SLR-178	The pod shall react properly to the "power-on" signal available as a 28 V discrete signal from the aircraft.	M	A
SLR-179	The pod shall react properly to the "zeroize" signal available as a 28 V discrete signal from the aircraft.	M	A
SLR-180	The pod shall output live sensor data as RS-170 standard video.	M	A
SLR-151	2.4 Security and Safety	E	
SLR-153	The pod shall be able to destroy all stored data in accordance with AEDP-03, Sanitization Level #2 "Purge" upon receiving a zeroize command.	M	A

ID	Technical Requirements	Req. Type	Verif. Method
SLR-155	The pod shall be safe to operate and maintain, meaning that all safety risks shall have a Risk Assessment Code less than "Medium" according to MIL-STD 882.	M	A
SLR-156	2.5 Environment	E	
SLR-181	The pod shall ensure that the temperature around the camera does not change at a rate higher than +/- 5 degrees Celcius per hour in order to avoid condensation when climbing from 0 to 10,000 ft with a climb rate of 50,000 ft/min.	M	A
SLR-162	The pod shall be able to sustain the shock and vibration loads present during flight, mounting and transportation. This requirement will be handled by Terma through Finite-Element modeling.	O	
SLR-163	The pod shall be able to operate under the climatic conditions ranging from "A2 - Hot Dry" to "C2 - Cold" for deployment on aircraft defined in AECTP-230.	M	A
SLR-169	2.6 Transportation Dolly	E	
SLR-170	The transportation dolly shall be able carry the weight of the URP.	M	A
SLR-171	The transportation dolly loaded with a URP shall be operatable by a single person.	M	A
SLR-172	The transportation dolly shall be able to lift and lower a URP for mount and dismounting on a F-16 (both when the aircraft is empty and when it is fully loaded).	M	A
SLR-173	The transportation dolly shall be safe to operate and maintain, meaning that all safety risks shall have a Risk Assessment Code less than "Medium" according to MIL-STD 882.	M	A
SLR-174	The transportation dolly shall be able to operate under the climatic conditions ranging from "A2 - Hot Dry" to "C2 - Cold" defined in AECTP-230.	M	A