Výzkumný a zkušební letecký ústav, a.s.
Beranových 130, 199 00 Praha - Letňany
OR : Městský soud v Praze,oddíl B,vložka 446
IČO: 00010669 DIČ: CZ00010669
Bankovní spojení : [redacted]

OBJEDNÁVKA

Číslo : OV4230592/2

Zakázka : ILEOS0
Středisko : 4000
Počet listů : 1

Huld s.r.o.

náměstí Winstona Churchilla 18
130 00 Praha 3, Žižkov

Vyřizuje / linka: [redacted]

Praha - Letňany
23.08.2023

P.č.	Množství / M.j.	Specifikace	Cena bez DPH
1	150,00 hod	Objednáváme u vás: Vývoje komponent pro měření a řízení teploty. Termín dodání : říjen 2023 Platební podmínky : bankovním převodem Dodací podmínky : dodat na adresu firmy /7.00 - 13.00 h/ Na daňovém dokladu (dodacím listu) uvádějte prosím č. naší objednávky. Žádáme Vás o potvrzení přijaté objednávky včetně termínu dodání a ceny. V případě vystavení zálohové faktury Vás žádáme o zaslání daňového dokladu o přijaté platbě (dle zákona o DPH č.235/2004 Sb., §26). FAKTURY PROSÍM ZASÍLEJTE EMAILEM NA [redacted] VZLÚ je povinným subjektem dle zákona č. 340/2015 Sb. o registru smluv. Smlouva/objednávka, mimo části podléhající obchodnímu tajemství, bude v souladu s tímto zákonem uveřejněna v registru smluv. Smlouva/objednávka nabývá platnosti dnem podpisu oběma smluvními stranami a účinnosti dnem uveřejnění v registru smluv. Objednatel se zavazuje tuto smlouvu/objednávku bez zbytečného odkladu po jejím podpisu oběma smluvními stranami, zaslat správci registru smluv k uveřejnění	[redacted]

Razítko a podpis [redacted]	Razítko a podpis dodavatele :

Telefon : [redacted]
Fax: [redacted]
e-mail: [redacted]

COVER LETTER

From: **Huld s.r.o.**

Date: 06.09.2023

To: **Czech Aerospace Research Centre**
Beranovych 130, 199 05 Prague - Letnany
Czech Republic
Attn: [redacted]

Subject: **Temperature Measurement & Control for small satellites**

Category: Offer
in response to VZLU request for proposal, ref: VZLU_email-2023/08/10

Our Ref.: HULD-CZ/2023/0072.20

Dear Sir,

With reference to the above Request for Proposal (RFP), we are pleased to present this proposal:

1. The Tenderer (potential Contractor) is:

   Huld s.r.o,
   Nám.Winstona Churchila 1800/2, Prague 3, 130 00, Czech Republic
   Telephone: +420 734 424 818

   Nationality (according to ESA Convention's criteria): **Czech**
   VAT Number: **CZ04332351**
   ESA Entity Code: **1 000 023 002**

2. The contact person of the Tenderer to whom all communications relating to this tender should be addressed is the following:

   a) for technical matters as follows:

	To:	With copy to:
Name	[redacted]	[redacted]
Telephone No.		
Email Address		

   b) for contractual and administrative matters as follows:

	To:	With copy to:
Name	[redacted]	[redacted]
Telephone No.		
Email Address		

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c) for Personal Data Protection matters to be addressed to the Data Protection contact point as follows:

	To
Name	[redacted]
Telephone No.	
Email Address	
Mail Address	Nám.Winstona Churchila 1800/2, Prague 3, 130 00, Czech Republic

3. The legal representative to sign the resulting Contract on behalf of the Contractor will be: Anna Rojková.

4. The Proposal is valid during the following time period, reckoning from the closing date for tender submission: **3 months**

Done and signed for and on behalf of **Huld s.r.o.**:

Signature: [redacted]

Name and title of the signatory: [redacted] **under PoA** duly authorised to commit the tendering entity and its proposed Subcontractor(s) if any, for this purpose.

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DETAILED OFFER

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1 INTRODUCTION

1.1 Purpose and Scope

This document is the offer prepared by Huld s.r.o. in response to the VZLU Request for Proposal, ref: VZLU_email-2023/08/10 for the Temperature Measurement & Control.

1.2 References

1.2.1 Applicable Documents

The following list of documents contains documents made applicable for establishing this document.

ID	Title	Doc Ref	Issue	Issue Date
AD-01	Temperature Measurement & Control	VZLU_email-2023/08/10	-	10/08/2023

1.2.2 Referenced Documents

The following list holds documents given as references.

ID	Title	Doc Ref	Issue	Issue Date
	none			

1.3 Glossary

Short	Description
ADC	Analog-to-Digital Converter
AI	Artificial Intelligence
ASW	Application Software
COTS	Commercial off-the-shelf
CSW	Central Software
CSP	CubeSat Space Protocol
DAC	Digital-to-Analog Converter
DPU	Data Processing Unit
ESA	European Space Agency
FPGA	Field Programmable Gate Array
GNSS	Global Navigation Satellite System
HW	Hardware
IMU	Inertial Measurement Unit
ISVV	Independent Software Verification & Validation
ML	Machine Learning
MPSoC	Multiprocessor system on a chip
OBC	On-Board Computer
SW	Software
T&M	Time and Material
TBC	To be clarified

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2 TECHNICAL PART

2.1 Understanding the main technical objectives & requirements

The main objective of this activity is to design, develop and validate SW for temperature control at satellite.

The SW will consist to two components:

- firmware executed inside MSP430,
- software library for ARM computer

The MCU firmware will be bare-metal application responsible for PT100/1000 measurement, communication, and configuration. The application is assumed to be written from scratch with possible reuse of codes and libraries provided by VZLU.

The ARM driver will be responsible for communication with MSP430. The library for ARM will be created to fit current VZLU framework.

The software will be developed in high-level language C or C++.

The exact requirements are TBC, but we expect the SW will be capable of:

- Measure PT100/1000 temperature
- Communication between MSP430 and OBC (e.g. CubeSat Protocol, KISS)
- Manage the configuration
- Pass the measure values to higher level of the system
- Basic FDIR
- Low resource consumption

The SW shall be tested using automated unit tests with 100% code coverage. There is no requirement related to Static Code Analysis but based on our experience and internal code quality guides we recommend applying e.g., MISRA. The tool can analyse the code related to common defects, vulnerabilities, bugs, or suspicious code. It can also check code related to reusability maintainability and testability.

2.2 Items Made Available by the Customer

VZLU will provide to Huld (TBC)

- Libraries & source code intended for re-use (if any)
- Available applicable documentation (ICD, etc)
- Exact requirements and needed clarifications
- VZLU Framework, if required to be used during development
- HW required for development & tests

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3 MANAGEMENT & IMPLEMENTATION PART

3.1 Background Experience

Huld s.r.o, former Space Systems Czech (SSC), is primarily a software engineering company specialized in safety-critical software and complex data processing. It was established in 2015 as a sister company of Space Systems Finland (SSF), fully adopting its culture, practices, and quality standards.

After succeeding a merge in the Q4/2019, between the former Space Systems Finland (SSF), Space Systems Czech (SSC) and RD Velho; the new brand and name of the company is **HULD**.

In the space domain, Huld s.r.o. has a proven success record for in time and quality development of operational on-board software, data processing, independent software verification and validation, as well as the development of an EGS-CC based Mission Control System and a Ground Segment for Nanosatellites, through which we learned the ESA processes applicable to software development.

Beside that we also focus on various technology studies especially in the GNSS and AI/ML fields. HULD s.r.o. also provides services in terms of digital security and functional safety.

3.1.1 Flight Software & ISVV

Our space software projects:

- PLATO Spacecraft Software
  Mission objective of the “PLAnetary Transits and Oscillations of stars” is detection of terrestrial exoplanets. Huld Finland is the Spacecraft Software Prime in a consortium led by OHB while Huld Czech provides support to this activity.
- HERA MILANI CubeSat
  Is part of deep space mission Hera. The CubeSat will be deployed at Didymos/Dimorphos binary asteroid system. It will operate autonomously for 3-6 months near the asteroid and capture scientific data including hyperspectral images. We are responsible for On-Board Software and Data Processing Unit development. The DPU contains industry standard as well as experimental AI algorithms to measure image quality. The AI is optimized for reliable operation in deep space mission. The DPU employs Xilinx Zynq device.
- HERA AI-FDIR
  Project's goal is to design and develop AI-based failure detection application. The AI will be deployed on Hera OBC and allow faster and better anomaly detection and prediction. The AI is optimized to run in limited resources provided by Leon platform.
- HERA ISVV
  Responsibility for Independent Validation and Verification (ISVV) of the HERA on board software (SPACEBEL).
- Ariane-6 Sequencer for multiple payloads separation (MLS)
  Development of the flight software for the A6 MLS Sequencer as a part of the consortium led by SAB Aerospace.
- Sentinel-4 UVN
  Implementation of validation tests for MIL-STD-1553B data bus (Milbus), which is the main bus for command and control of instrumentation and platform units.

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- BepiColombo ISVV
  Participation in ISVV for the central software, failure control electronics and solid-state mass memory.
- Sentinel-4 L 1b Prototype Processor
  Contribution to the development of the L1b prototype data processing software, mainly implementation of test operations with L1b data.
- Data Analytics Platform for Climate Resilience (DAP4CR)
  Contribution to the implementation of the data distribution platform and integration of data sources in the Czech Republic.
- MetOp-SG Scatterometer (SCA)
  Development of the DCU Application SW (ASW) together with the Prime (Airbus DS)
- Biomass Central Software (CSW)
  Contribution to the development of the Payload management within the CSW

3.1.2 Software Defined Radios

Huld has experience with software defined radios based in Xilinx Zynq devices. The details are under NDA but we can share the device used was Eclypsy Z7. The device employs MSPS ADC and DAC and is capable to continuously sample and filter the data.

3.1.3 GNSS Technologies

In cooperation with the GSA/EUSPA, Huld s.r.o. developed **TIIRA GNSS receiver and positioning platform.**

TIIRA is an open source / open hardware Galileo receiver in a small form, based on multiple core parallel microkernel architecture, and ready for integration with other sources of information like inertial sensors and ultra-wideband radio for cooperative navigation.

Its unique features include system modularity, an openness of software and hardware designs, and signal processing running in dedicated soft-core processors supported by an accelerator implemented in hardware logic.

Main features:

- modern design with MPSoC FPGA
- software defined and parallel processing of multiple satellites
- IMU composed of three-axes gyroscope and accelerometer
- cooperative & working in problematic environments
- multi-sensor card
- navigation algorithms
- tri-band
- scalable to GNSS premium and mass market

The product is designed for the premium mass market and shall enable the development of a family of advanced Galileo receivers not existing today.

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Advanced Algorithms and techniques for Resilient Time Provision:

The goal of this activity is to design, develop, implement, and validate a prototype capable of generating accurate and stable timing information with high level of integrity and availability. To achieve this objective, the system combines (or fuses) the input timing information provided by several timing sources, each generally with different characteristics. The prototype will implement algorithms based on hybrid (frequency-time) Kalman filters and machine-learning techniques.

Block-Box for an Optimised GNSS Spectrum Monitoring Network using AI

The goal of this project is to design, develop, implement, and validate a system capable of detecting and mitigating GNSS jamming and spoofing using state-of-the-art AI/ML techniques. The system will consist of local and cloud parts. The local part samples the GNSS signal from the antenna, analyses and cleans it using state-of-the-art AL/ML algorithms and retransmits it to the COTS GNSS receiver. The local part can sample and store the input data for later analysis. The cloud part is capable of downloading sampled data, storing and analysing them, and producing reports based on inputs from the network of the local block-box terminals.

3.1.4 Ground Segment

The HULD team has know-how in the Ground Segment infrastructure gained during the development of our EGS-CC based Mission Control System ORBITCON.

ORBITCON is an EGS-CC based Mission Control System (MCS) customized for the nanosatellite missions. The MCS is provided in form of software-as-a-service (SaaS), or in a broader sense

ORBITCON architecture is based on hybrid-cloud setup so that user's data aren't stored in a public cloud provider's storage but securely managed on a private server. Due to generic architecture and protocol agnostic approach, a variety of missions can be supported at different levels, starting with the simple provision of raw data exchange, and ending with the management of complex communication on a space link.

The ORBITCON MCS was validated in real world via our ground station at the University of West Bohemia in Pilsen, Czechia (coordinates: N 49.723768 E 13.349445) where we established a connection in the UHF radio frequency band with two CubeSats: VZLUSAT-1, OK0SAT (Lucky-7).

3.1.5 Security Engineering, Consulting & Support

Huld has an extent portfolio of services in terms of digital security and functional safety, covering:

- Security management
- Technical security including security assessments, analysis of configuration, code analysis as well as backend hardening, penetration testing
- Industrial & software security including the knowledge of risk management, secure development, and service operations
- Embedded hardware/software security (interfaces, components and covering, physical device hardening, protocols, data authenticity and integrity, data exchange and update mechanisms, data communication chain)
- Cloud & digitalization security including data protection, communication protection, identity and access management, monitoring, and risk analysis

The main domains in which we are operating are industrial systems, automotive and transportation, process industry, telecom, national security. Standards we are using in our projects are IEC 62443, ISO 27001, ISO 21434, NIST, ENISA IoT, ETSI, IEC 61508, ISO 26262, ISO 13849, EN 5012X.

For ESA, we perform, together with the GNSS Centre of Excellence, an activity related to the GNSS vulnerability and the influence of GNSS jamming and spoofing on the critical infrastructure.

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3.2 Schedule Assumptions & Constraints

The indicated overall mission schedule:

- VZLU Engineering model (V1) to be ready in Autumn 2023
- VZLU Integration activities planned for beginning of 2024

Schedule indicated by VZLU for this activity:

- Activity Kick-off by end of August 2023
- Delivery of Firmware for MSP430 by end of October 2023
- Delivery of Software library for ARM computer by November 2023

3.3 Deliverable Items

Item ID	Deliverable	Quantity	Notes
	Software		
SW1	Software library for ARM computer (OBC)	1x	C/C++ code
FW1	Firmware for MSP430 microprocessor	1x	C/C++ code

Table 1: Deliverable Items

The SW1 and FW1 are independent. Based on final agreement the contractor can deliver both or one of the listed items.

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4 FINANCIAL PART

4.1 Price Type

The price is proposed as Time and Material (T&M) at economic conditions 09/2023.

4.2 Taxes and Custom Duties

All given prices are free of any Value Added Taxes (VAT) and import duties in the Agency's Member States.

VAT will be added on top of the price according to applicable legal regulations.

4.3 Initial effort estimation

The preliminary effort estimation based on information exchanged with VZLU, is:

- 3 to 4 man-weeks for firmware for the MSP430 microprocessor (FW1)
- 4 to 6 man-weeks for the Software library for ARM computer (SW1)

As agreed with VZLU, procurement of 150h (T&M) is proposed.

The amount can be adjusted, depending on VZLU needs.

4.4 Price

4.4.1 Basic Price

[redacted]

4.4.2 Discount for an early order

In case the order/contract is signed by 15th September 2023, the proposed HULD T&M rate (w/o VAT) for calendar year 2023 is 1000 CZK/h.

This reduced T&M rate leads to [redacted]

4.5 Payment Plan

The payments for effort done are proposed to be invoiced on bi/monthly (TBC) bases in CZK.

< end of the document >

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