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Ver.Rev	Date	Modified by	Section/ Paragraph modified	Change description
1.0	30.04.2025	JBO, NCZ	All	First issue
1.1	24.06.2025	JBO	Section 2	Explanation of report naming convention in the introduction.
1.2	02.07.2025	NCZ	Section 6.4 Section 6.1.2	A new chapter on launch systems. Adding confirmation of achievable performance and technical budget.

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1 Applicable and reference documents

Applicable and reference documents are listed in tables below.

1.1 Applicable documents

No	Doc title	Doc Identifier	Ver.Rev
AD1.	Umowa MIKROGLOB02	AU/135/V/2024	20.12.2024
AD2.	Concept of Operations	MGB02-RP-CTI-SY-0009	V3.1
AD3.	Mission Analysis Report	MGB02-RP-CTI-SY-0010	V3.1
AD4.	Space debris mitigation plan	MGB02-PL-CTI-SY-0011	V3.0
AD5.	Product tree	MGB02-PT-CTI-PM-0013	V3.1
AD6.	Project management plan	MGB02-PL-CTI-PM-0014	V3.0
AD7.	Work breakdown structure	MGB02-WBS-CTI-PM-0015	V3.0
AD8.	Work package description	MGB02-WPD-CTI-PM-0016	V3.0
AD9.	Schedule	MGB02-SC-CTI-PM-0017	V3.0
AD10.	Configuration item list	MGB02-LI-CTI-CM-0019	V3.1
AD11.	Risk assessment report	MGB02-RP-CTI-PM-0022	V3.1
AD12.	Coordinate system document	MGB02-FI-CTI-SY-0025	V3.1
AD13.	System External Interface Control Document	MGB02-ICD-CTI-SY-0026	V3.1
AD14.	Space-to-Ground Interface Control Document	MGB02-ICD-CTI-SY-0027	V3.1
AD15.	Space Segment engineering plan	MGB02-PL-CTI-SS-0029	V3.0
AD16.	Space Segment Verification plan	MGB02-PL-CTI-SS-0031	V3.1
AD17.	Space Segment AIT plan	MGB02-PL-CTI-SS-0032	V3.1
AD18.	Space Segment Design Definition Document	MGB02-DD-CTI-SS-0033	V3.1
AD19.	Space Segment Interface control document	MGB02-ICD-CTI-SS-0034	V3.1
AD20.	Ground segment engineering plan	MGB02-PL-CTI-GS-0036	V3.0
AD21.	Ground Segment Interface Control Document	MGB02-ICD-CTI-GS-0037	V3.1
AD22.	Ground segment design definition document	MGB02-DD-CTI-GS-0038	V3.2
AD23.	Ground Segment Configuration Management Plan	MGB02-PL-CTI-CM-0039	V3.1
AD24.	Operations engineering plan	MGB02-PL-CTI-SY-0072	V2.1
AD25.	Space Segment Subsystems Design Definition Document	MGB02-DD-CTI-SS-0073	V2.1
AD26.	Ground segment subsystems design definition document	MGB02-DD-CTI-GS-0074	V2.2
AD27.	CDR Review Report	MGB02-RP-CTI-PM-0075	V1.1

AD28.	GSCDR Review Report	MGB02-RP-CTI-PM-0076	V1.1
AD29.	Mission Operations Plan	MGB02-PL-CTI-SY-0098	V2.1
AD30.	Space and ground segment monitoring and control databases	MGB02-FI-CTI-SY-0099	V2.1
AD31.	Ground segment verification plan	MGB02-PL-CTI-GS-0139	V3.1
AD32.	Ground segment AIT plan	MGB02-PL-CTI-GS-0140	V3.1
AD33.	Annex to Space Segment Design Definition Document - Data Budget	MGB02-BDG-CTI-SS-0165	V2.0
AD34.	Annex to Space Segment Design Definition Document - Link Budget	MGB02-BDG-CTI-SS-0166	V2.0
AD35.	Annex to Space Segment Design Definition Document - Power Budget	MGB02-BDG-CTI-SS-0167	V2.1
AD36.	Annex to Space Segment Design Definition Document - Mass Budget	MGB02-RS-CTI-SS-0169	V2.1
AD37.	CDR & GSCDR Organization Review Procedure	MGB02-PR-CTI-PM-0191	V1.1
AD38.	CDR & GSCDR RID Summary	MGB02-RIDS-CTI-PM-0192	V1.0
AD39.	Annex 1 to Space Segment Interface control document	Appendix 1 to 0034	V3.0
AD40.	Annex 2 to Space Segment Interface control document	Appendix 2 to 0034	V3.0
AD41.	Appendix 1 to Space segment AIT plan	Appendix to 0032	V3.1
AD42.	Appendix 1 to Ground segment AIT plan	Appendix to 0140	V3.0
AD43.	Risk Register	MGB02-CO-CTI-PM-0065	V3.1
AD44.	Annex 1 to Space Segment Subsystems Design Definition Document - Structure	MGB02-DD-CTI-SS-0193	V1.1
AD45.	Annex 2 to Space Segment Subsystems Design Definition Document - AOCS	MGB02-DD-CTI-SS-0194	V1.1
AD46.	Annex 3 to Space Segment Subsystems Design Definition Document - Command & Data Handling	MGB02-DD-CTI-SS-0195	V1.1
AD47.	Annex 4 to Space Segment Subsystems Design Definition Document - Communication	MGB02-DD-CTI-SS-0196	V1.0
AD48.	Annex 5 to Space Segment Subsystems Design Definition Document - EPS	MGB02-DD-CTI-SS-0197	V1.0
AD49.	Annex 6 to Space Segment Subsystems Design Definition Document - Payload	MGB02-DD-CTI-SS-0198	V1.1
AD50.	Annex 7 to Space Segment Subsystems Design Definition Document -TCS	MGB02-DD-CTI-SS-0199	V1.1
AD51.	Annex 8 to Space Segment Subsystems Design Definition Document - WHDE	MGB02-DD-CTI-SS-0200	V1.0
AD52.	Annex 1 to Space-to-Ground Interface Control Document - Payload	MGB02-ICD-CTI-SY-0201	V1.1

AD53.	Space debris mitigation report	MGB02-RP-CTI-SY-0085	V1.1
AD54.	APID assignment	MGB02-SW-CTI-SY-0201	V1.1
AD55.	Glossary of Abbreviations and Definitions	MGB02-GAD-CTI-PM-0136	V3.1
AD56.	SCID assignment	MGB02-TN-CTI-SS-0397	V1.0
AD57.	Communication Encryption Design Document	MGB02-TN-CTI-SS-0270	V1.1

1.2 Reference documents

No	Doc title	Doc Identifier	Re
RD1.	Project Planning and Implementation	ECSS-M-ST-10C	Re.1

2 Introduction

This document is issued in reference to §2(13) of Contract No. AU/135/V/2024 dated 20 December 2024 (AD1) It has been prepared in the context of the Recovery and Resilience Facility (RRF) and the Polish National Recovery and Resilience Plan (KPO).

The MIKROGLOB project is implemented under Investment A2.6.1 – "Expansion of the national system of monitoring services, products, analytical tools, and supporting infrastructure using satellite data."

This report constitutes one of three documents (Mission Definition Review, Preliminary Requirements Review, Critical Design Review) indicated in the official KPO monitoring table as qualitative indicators for milestone A9L.

The project work under milestone A9L was divided according to ECSS methodology into three phases:

- Phase 0/A (mission feasibility study),
- Phase B (early mission definition),
- Phase C (detailed mission definition).

For the purpose of preparing the reports that serve as qualitative indicators for the milestone, and using the report names provided in the KPO documentation description, the following assignment of phases to reports will be applied:

- Phase 0/A – Mission Definition Review Report,
- Phase B – Preliminary Requirements Review Report,
- Phase C – Critical Design Review Report.

The present document provides a public summary of the Phase C results and accompanies the Contracting Authority's reporting obligations toward Polish and EU institutions.

Due to the incremental nature of the project's implementation, the following study refers to one or more applicable documents at a time. Multiple references are used wherever the contracting authority specified deliveries of documents in an incremental form.

3 Scope

This report covers the full set of activities carried out under Phase C of the MIKROGLOB project, culminating in the Critical Design Review (CDR) and Ground Segment Critical Design Review (GSCDR).

The scope includes:

- Consolidation and finalisation of detailed technical requirements;
- Definition and validation of system, segment, and subsystem architectures;
- Verification of the completeness and maturity of design documentation;
- Finalisation of interface control and test documentation;
- Final updates to planning documents, configuration baselines, and risk assessments.

The report reflects the formal technical status presented during CDR/GSCDR and is aligned with the updated documentation submitted as per applicable documents (e.g. AD2, AD18, AD19, AD26).

4 Purpose

The purpose of this report is to provide a structured and publicly accessible summary of the Phase C results, validating the system's readiness to transition into Phase D (implementation and integration).

The report also supports the evaluation of MIKROGLOB's progress against KPO-defined quality indicators and funding requirements under the RRF framework. Additionally, it supports the Contracting Authority's formal reporting obligations as stated in §2(13) of the main contract (AD1).

5 Project Overview

5.1 Phase Status Summary

Phase C of the MIKROGLOB project was initiated following successful completion of Phase B and contractual confirmation (AD1). Nominal activities spanned the period from April 2025 to May 2025 (although significant amount of work has been done in parallel to Phase B) and concluded with the successful execution of the Critical Design Review (CDR) and Ground Segment Critical Design Review (GSCDR).

All major technical and programmatic objectives were achieved, including approval of:

- Space Segment Design Definition Document (AD18),
- Ground Segment Design Definition Document (AD22),
- Segment-level AIT and Verification Plans (AD16, AD17, AD31, AD32),
- Interface Control Documents (AD19, AD21),
- Subsystem-level design annexes and budgets (AD33–AD36, AD44–AD51).

The project was cleared for transition to Phase D, pending follow-up on a limited set of recommendations and clarifications raised during the reviews (AD27, AD28).

5.2 Work Organisation and Planning

Phase C was implemented under the management structure defined in the Project Management Plan (AD6), with technical execution led by the Engineering Team in collaboration with subsystem and segment leads.

Activities were scheduled and tracked using the updated baseline schedule (AD9). The Work Breakdown Structure (AD7) and associated Work Package Descriptions (AD8) were maintained and updated accordingly.

The development workflow followed ECSS standards, with formal documentation prepared for all system and subsystem elements. Configuration control was ensured through the Configuration Management Plan (AD23) and the Configuration Item List (AD10).

5.3 Risk Assessment Summary

Risk management in Phase C was conducted in line with the Risk Assessment Report (AD11) and Risk Register (AD43). Special attention was paid to risks with the highest pre-mitigation severity, notably:

- Loss of satellites due to launch failure – identified as a high-severity risk due to potential mission failure. Mitigated through dedicated launch insurance and reconstitution planning (AD43);
- Extended commissioning and LEOP risks – managed through operations simulations, redundancy, and autonomous onboard procedures (AD29);
- Communication and interface disruptions – addressed via thorough validation of ICDs across system boundaries (AD13, AD14, AD19–AD21);
- Performance margins in optical payload and subsystem maturity – mitigated through targeted qualification campaigns and updated AIT plans (AD15–AD17, AD25–AD26);
- Ground Segment integration delays and facility constraints – handled via alternative hosting options, adjusted deployment schedules, and backup test infrastructure (AD20–AD24).

These and other risks were systematically reviewed during CDR and GSCDR. All high-priority items are now tracked with mitigation actions assigned, and the programme transitions to Phase D with an acceptable overall risk posture.

6 Technical Status

6.1 Space Segment

6.1.1 Architecture Overview

The space segment architecture was consolidated during Phase C and validated through the Critical Design Review process. The baseline configuration includes a constellation of four microsatellite-class platforms. The constellation is designed to deliver high-resolution optical Earth Observation data.

Each satellite integrates optoelectronic payload, precise AOCS capabilities, and standardised platform avionics. The spacecraft design includes a high-throughput data handling subsystem and radio communications. The system incorporates a data compression module and secure communication links using encryption. These components are integrated into a standardised platform layout to ensure compatibility and scalability across the constellation.

The constellation design optimises temporal revisit and global coverage objectives, based on updated mission analysis (AD3) and the validated Concept of Operations (AD3). The system complies with orbital debris mitigation, attitude control accuracy, power autonomy, and thermal management requirements. The space segment architecture and its constituent satellite platforms are detailed in the Space Segment Design Definition Document (AD18) and supporting annexes (AD33–AD36, AD44–AD51).

6.1.2 Subsystem Requirements and Designs

All primary spacecraft subsystems were finalised and documented at the unit and interface level.

This includes:

- Attitude and Orbit Control System (AOCS)
- Electrical Power Subsystem (EPS)
- Thermal Control Subsystem (TCS)
- Telemetry, Tracking, and Command (TT&C)
- Command and Data Handling (C&DH)
- Optical Payload Unit (OPT)
- Communications payload (COMM)

Each subsystem is described in the Subsystem Design Definition Documents (AD25, AD44–AD51). Engineering budgets for power, mass, thermal, and data rates (AD33–AD36) demonstrate consistency with system-level constraints and Phase C design maturity criteria.

Subsystem-level verification activities and qualification readiness are documented in the Space Segment Verification Plan (AD16) and the Assembly, Integration, and Testing Plan (AD17), consistent with ECSS-E-ST-10-02C and ECSS-E-HB-10-02A.

The Critical Design Review (CDR) confirmed that the system's performance meets the customer's requirements and that the technical reserves and engineering margins are sufficient to meet the mission. This validation is based on documented linkage to system requirements, a validation plan, and consolidated engineering analyses that demonstrate alignment with mission objectives.

6.1.3 Interface Definition Status

All space segment interfaces were finalised and baselined in the Space Segment Interface Control Document (AD19), with supporting annexes covering structural, electrical, thermal, and data interfaces (AD39, AD40). Interfaces between satellite subsystems, and between the platform and payload, were documented with identified ICDs and data exchange formats.

Cross-segment interfaces—particularly with the ground segment and launcher—were defined at system level (AD13, AD14), ensuring compatibility in data protocols, command interfaces, and integration environments. Interface design followed ECSS-E-ST-70-31C and ECSS-E-ST-70-41C standards.

6.2 Ground Segment

6.2.1 Architecture and Functional Concept

The ground segment comprises dual, redundant control centres, mission planning systems, telemetry and command infrastructure, and data processing facilities. The architecture supports secure and autonomous operations, enabling real-time LEOP and nominal mission control.

The design includes interfaces with external stakeholders (e.g. NSIS), redundancy for critical operations, and geographic dispersion to meet security and continuity criteria. The Ground Segment Design Definition Document (AD22) and Ground Segment Engineering Plan (AD20) provide detailed architecture descriptions.

6.2.2 Subsystem Definition and Interface Status

Subsystem definitions, including communications, network infrastructure, data handling, and user interfaces, are documented in the Ground Segment Subsystems Design Definition Document (AD26). Interoperability with the space segment was elaborated in the Ground Segment ICD (AD21) and Space-to-Ground ICD (AD14), including encryption and command routing.

Verification and AIT plans (AD31, AD32) detail subsystem validation flows. Subsystem testing will be carried out in staging environments before full operational deployment.

6.3 System Engineering and Integration

6.3.1 Requirements Traceability

All system and segment-level requirements are traceable to design solutions and verification procedures via the updated traceability matrix (included in AD18, AD25). Verification logic is defined in the Segment Verification Plans (AD16, AD31), ensuring each requirement is allocated to a test, analysis, or inspection step.

6.3.2 Verification and Validation Planning

The verification strategy was finalised in Phase C, including segment-level test plans (AD16, AD31), environmental test flows, and component qualification logic. Test readiness for Phase D was reviewed and approved during CDR/GSCDR.

6.3.3 AIT Concept

AIT activities are governed by segment-specific plans (AD17, AD32), covering environmental, functional, and system-level integration. GSE requirements, test environments, and model configurations are defined. Appendix 1 to AD17 and AD32 include step-by-step AIT procedures and configurations.

6.3.4 Operations Planning Approach

Operational readiness was addressed through the Operations Engineering Plan (AD24) and the Mission Operations Plan (AD29). These define mission phases, command authority, anomaly handling, and autonomy levels. LEOP and commissioning operations are supported by tailored planning assumptions and redundancy schemes.

6.4 Launch system

A detailed verification of the system's compatibility with the selected launch system was carried out as part of the ongoing cooperation with the selected supplier. This confirmation not only ensures technical compatibility, but also ensures readiness for integration, enabling launch operations to be carried out without delays and additional risks. The schedule for satellite launches remains unchanged.

7 Programme Management Status

7.1 Schedule and Progress vs. Baseline

The project progressed in line with the updated baseline schedule (AD9), with minor deviations managed through internal reallocation of resources and prioritisation of critical paths. Key Phase C milestones—including internal reviews, subsystem freezes, and the final CDR/GSCDR—were achieved as planned. Buffer margins incorporated during the planning phase absorbed small variations without impact on the transition timeline to Phase D.

Progress monitoring was conducted against the contractual schedule defined in the Project Management Plan (AD6), with weekly updates consolidated in the internal project tracking system. Segment integration and documentation delivery were aligned to the reviewed planning assumptions in the Work Package Descriptions (AD8).

7.2 Work Breakdown Structure and Deliverables Overview

The Work Breakdown Structure (WBS) maintained in AD7provided the backbone for deliverable tracking and effort allocation throughout Phase C. Updates were reflected in the Work Package Descriptions (AD8), enabling consistent monitoring of scope, ownership, and configuration dependencies.

Deliverables were tracked across all major domains—space segment, ground segment, system engineering, AIT, verification, and programmatic control. Configuration-controlled documents were submitted through the Configuration Management system in line with the CM Plan (AD23) and reviewed during internal Design Freeze and pre-CDR checkpoints.

7.3 Configuration Management and Documentation

Configuration management was implemented in accordance with the Configuration Management Plan (AD23) and supporting Configuration Item List (AD10). All major configuration items were baselined prior to the final CDR/GSCDR milestone and managed via formal change control procedures.

A single source of documentation truth was maintained within the project's dedicated document management system, ensuring traceability and consistency across design files, interface definitions, verification logic, and schedule dependencies.

Document versions referenced in this report and accepted at the CDR/GSCDR stage were submitted in accordance with the review procedure (AD37) and are archived in project repositories under formal version control.

7.4 Risk Management

Risk management during Phase C was executed in line with the Risk Assessment Report (AD11) and maintained through the Risk Register (AD43). Risk reviews were held monthly and in advance of major milestones, with preventive and corrective measures updated accordingly.

Highest-severity risks included:

- Potential launch failures (mitigated through insurance and reconstitution plans);
- Ground Segment deployment delays (addressed through flexible implementation and relocation options);
- Subsystem maturity risks (mitigated by early integration and qualification);
- Cybersecurity threats (countered by encrypted links and system autonomy);
- Supplier and schedule-related risks (managed via buffers and early contracting).

All residual risks were found to be within acceptable thresholds for entering Phase D, as confirmed during the CDR/GSCDR reviews.

8 Documents Delivered and Reviewed

This section summarizes the documents submitted and approved during the formal review milestones in Phase C. Each review was conducted in accordance with the relevant organizational procedure and documented in the relevant review reports (AD27AD28) and RID summary (AD38). All items listed were subject to configuration control and constitute the formal reference basis for the transition to Phase D.

8.1 Documents Accepted at CDR

Document Identifier	Document Title	Revision
MGB02-PL-CTI-SS-0031	Space Segment Verification plan	V3.0
MGB02-PL-CTI-SS-0032	Space Segment AIT plan	V3.0
MGB02-DD-CTI-SS-0033	Space Segment Design Definition Document	V3.0
MGB02-ICD-CTI-SS-0034	Space Segment Interface control document	V3.0
MGB02-DD-CTI-SS-0073	Space Segment Subsystems Design Definition Document	V2.0
MGB02-BDG-CTI-SS-0165	Annex to Space Segment Design Definition Document - Data Budget	V2.0
MGB02-BDG-CTI-SS-0166	Annex to Space Segment Design Definition Document - Link Budget	V2.0
MGB02-BDG-CTI-SS-0167	Annex to Space Segment Design Definition Document - Power Budget	V2.0
MGB02-RS-CTI-SS-0169	Annex to Space Segment Design Definition Document - Mass Budget	V2.0
Appendix 1 to 0034	Annex 1 to Space Segment Interface control document	V3.0
Appendix 2 to 0034	Annex 2 to Space Segment Interface control document	V3.0
Appendix to 0032	Annex 3 to Space Segment Subsystems Design Definition Document - Command & Data Handling	V3.0
MGB02-DD-CTI-SS-0193	Annex 4 to Space Segment Subsystems Design Definition Document - Communication	V1.0
MGB02-DD-CTI-SS-0194	Annex 5 to Space Segment Subsystems Design Definition Document - EPS	V1.0

MGB02-DD-CTI-SS-0195	Annex 6 to Space Segment Subsystems Design Definition Document - Payload	V1.0
MGB02-DD-CTI-SS-0196	Annex 7 to Space Segment Subsystems Design Definition Document -TCS	V1.0
MGB02-DD-CTI-SS-0197	Annex 8 to Space Segment Subsystems Design Definition Document - WHDE	V1.0
MGB02-DD-CTI-SS-0198	Space-to-Ground Interface Control Document	V1.0
MGB02-DD-CTI-SS-0199	Operations engineering plan	V1.0
MGB02-DD-CTI-SS-0200	Annex 1 to Space-to-Ground Interface Control Document - Payload	V1.0
MGB02-RP-CTI-PM-0075	CDR Review Report	V1.0

8.2 Documents Accepted at GSCDR

Document Identifier	Document Title	Revision
MGB02-ICD-CTI-GS-0037	Ground Segment Interface Control Document	V3.0
MGB02-DD-CTI-GS-0038	Ground segment design definition document	V3.0
MGB02-DD-CTI-GS-0074	Ground segment subsystems design definition document	V2.0
MGB02-PL-CTI-GS-0139	Ground segment verification plan	V3.0
MGB02-PL-CTI-GS-0140	Ground segment AIT plan	V3.0
Appendix to 0140	Appendix 1 to Ground segment AIT plan	V3.0
MGB02-RP-CTI-PM-0076	GSCDR Review Report	V1.0

9 Conclusions

Phase C of the MIKROGLOB project has been successfully completed, achieving all major technical and programmatic objectives required for transition into the implementation and integration phase (Phase D).

The Critical Design Review (CDR) and Ground Segment Critical Design Review (GSCDR) confirmed the maturity, consistency, and completeness of the system and segment-level designs. The results demonstrate that the MIKROGLOB architecture—across space, ground, and operational domains—is technically feasible, well-documented, and implementable within the defined schedule and resource constraints.

All critical documentation packages were submitted, reviewed, and accepted, including subsystem-level Design Definition Documents, Interface Control Documents, AIT and Verification Plans, and updated configuration and management baselines (AD2–AD53). Risk assessment results show that residual risks remain within acceptable levels for entry into Phase D (AD11, AD43).

The project is now positioned to proceed with manufacturing, integration, and verification activities, in line with the approved configuration baselines and planning assumptions validated at CDR and GSCDR.

This report demonstrates that the project remains in full compliance with the objectives and qualitative indicators defined under the KPO framework (Milestone A9L). The maturity of the design and supporting processes confirms the project's readiness to advance into Phase D, thereby ensuring continued eligibility for Recovery and Resilience Facility (RRF) financing.