



FLORIS Calibration Unit

Long Lead Item List (LLI)

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|------------|--------------------|
| Doc : | FLX-LI-ALM-CU-0006 |
| Issue: | 4:0 |
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Almatech SA
EPFL – Innovation Park D
1015 Lausanne
Suisse

Tel : +41 21 555 3000
Tel : +41 21 555 3001
www.almatech.ch info@almatech.ch

Approval Sheet

Name

Date

Signature

Prepared by: T. Gandy

Approved by: M. Lai

Approved by: G Capo

Distribution List

Internal reference: ALM-PRO-3459

| Person | Organization | Distribution |
|-------------|--------------|--------------|
| L. Blecha | Almatech | C |
| G. Capo | Almatech | O |
| T. Gandy | Almatech | C |
| M. Lai | Almatech | C |
| | | |
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| | | |
| M. François | ESA | C |
| | | |
| A. Capanni | Leonardo | A |
| | | |

A = Approval
C = Copy
I = Information
O = Original
R = Review

Change Record

| Modification | Page | Iss. | Rev. | Date |
|---|-------------|------|------|------------|
| First Issue | all | 1 | 0 | 13.06.2017 |
| Update for URR | | 2 | 0 | 25.01.2018 |
| Resolver removed from design | 10 | | | |
| Updated for PDR acc. to URR actions | 10 | 3 | 0 | 19.07.2018 |
| Updated after PDR according to RID TC-12 | 11 & 12 | 4 | 0 | 17.01.2019 |
| Almatech order numbers added when available | 10, 11 & 12 | | | |
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1 Introduction

1.1 Project Overview

The Earth Explorer - Fluorescence Explorer (FLEX) mission will map vegetation fluorescence to quantify photosynthetic activity.

The conversion of atmospheric carbon dioxide and sunlight into energy-rich carbohydrates through photosynthesis is one of the most fundamental processes on Earth – and one on which we all depend.

Information from FLEX will improve our understanding of the way carbon moves between plants and the atmosphere and how photosynthesis affects the carbon and water cycles.

In addition, information from FLEX will lead to better insight into plant health and stress. This is of particular relevance since the growing global population is placing increasing demands on the production of food and animal feed. At the moment, photosynthetic activity cannot be measured from space, but FLEX's novel sensor will observe this faint glow.

The FLEX satellite will orbit in tandem with one of the Copernicus Sentinel-3 satellites, taking advantage of its optical and thermal sensors to provide an integrated package of measurements.

Mission objectives can therefore summarized as follows:

- To assess the quality of fluorescence-derived photosynthesis data against classical optically-based methods (i.e. from fraction of absorbed photosynthetically active radiation times Light Use Efficiency).
- To address in more detail temporal and spatial scaling issues (from towers to satellite footprints).
- To identify and characterize the effects of different types of stress on fluorescence and photosynthesis (especially drought and freezing air temperatures).
- To indicate potential applications of the novel fluorescence observations.

Mission orbit:

- Orbit: Sun-synchronous
- Measurement altitude: 815 km

The FLEX Space Segment consists of a single satellite carrying the FLuORescence Imaging Spectrometer (FLORIS) push-broom instrument. This high-resolution imaging spectrometer will acquire data in the 500– 780 nm spectral range, with a sampling of 0.1 nm in the oxygen bands (759–769 nm and 686–697 nm) and 0.5–2.0 nm in the red edge, chlorophyll absorption and Photochemical Reflectance Index bands.

The monthly global maps will have an on-ground spatial resolution of 300 × 300 m² with a swath width of 150 km.

1.2 Scope of the Document

This document lists the long lead items for the project.

2 Applicable and Reference Documents

2.1 Applicable Documents

| Ref. | Title | Reference | Iss. |
|--------|--|----------------------|------|
| AD 105 | Cover Letter | FLX-LET-FNM-INS-0003 | 3 |
| AD 106 | Special Condition of Tender | FLX-OF-FNM-INS-0001 | 4 |
| AD 100 | Contract for FLEX Unit/sub-system | Draft Contract | |
| AD 101 | Generic Statement of Work for FLEX Unit/sub-system | FLX-SOW-FNM-INS-0001 | 2 |
| AD 102 | Specific Statement of Work | FLX-SOW-FNM-INS-0005 | 2 |
| AD 103 | Floris Calibration Unit User Requirement Specification | FLX-RS-FNM-INS-0006 | 5 |
| AD 201 | FLORIS Radiation Environment RS | FLX-RS-FNM-INS-0016 | 4 |
| AD 202 | FLEX FEMM Requirements Specification | FLX-RS-FNM-INS-0023 | 1 |
| AD 203 | FLEX GMM &TMM Requirements Specification | FLX-RS-FNM-INS-0024 | 1 |
| AD 204 | FLEX CAD Model Requirements Specification | FLX-RS-FNM-INS-0025 | 1 |
| AD 205 | FLEX Cleanliness Requirements for Sub-contractors | FLX-RS-FNM-INS-0028 | 3 |
| AD 206 | FLEX Instrument General Design Interface Requirements | FLX-RS-FNM-INS-0029 | 3 |
| AD 208 | FLEX PA Requirements for Subcontractors | FLX-RS-FNM-INS-0021 | 2 |
| AD 209 | FLEX PA SW Requirements for Subcontractors | FLX-RS-FNM-INS-0022 | 1 |
| AD 210 | FLEX Configuration Control and Documentation Management Plan | FLX-PL-FNM-INS-0001 | 3 |
| AD 211 | FLEX List of Acronyms and Abbreviations | FLX-LI-FNM-INS-0003 | 2 |

2.2 Reference Documents

| Ref. | Title | Reference | Iss. | Date |
|-------------|--|----------------------|-------------|-------------|
| [RD01] | FLORIS Calibration Unit Almatech Proposal | 17-10S-225 | 1.0 | 15.06.2017 |
| [RD02] | Leonardo Clarification Letter | FLX-LET-FNM-INS-0009 | -- | 18.10.2017 |
| [RD03] | Floris CU Negotiation Meeting #1 between Leonardo and Almatech | FLX-MIN-FNM-INS-0041 | | 15.11.2017 |

2.3 Acronyms and Abbreviations

The abbreviations and acronyms used in this document are in accordance with [AD 211].

3 Long Lead Item List

| Item | description | type | lead time [wks] | Export control | reference | LLI procurement | | first need milestone |
|---------------------|--|--|--|-------------------|------------------------------|--------------------|-----|---|
| | | | | | | B2 | C/D | |
| harmonic drive | harmonic drive gear | CPL-17-2A | 25 + 4 (manufact. + lubrication @ESR) | No | ALM-ACH-2737 ALM-ACH-2824 | X | | CUIS Integration |
| bearing assembly | super duplex bearing with integrated preload device | super duplex bearing ADR WKSP20018HTA4D OK6819 | 32-34 | No | ALM-ACH-2582 | X | | CUIS Integration |
| drive motor | phytron stepper motor, space qualified | physpace 42-2 | 28 | | ALM-ACH-3000 ALM-ACH-3062 | X | | FM for CUIS Integration start (double winding needed) |
| Sun Diffuser | Spectralon CSTM- FLEX-SG Manufacturer: Labsphere | Space Grade Sphere and Spectralon part-#: CA-14020- MB0 | 20 - 32 | No | ALM-ACH-3068 | | X | EM for EQM Rotor Integration FM for PFM Sun Diffuser Integration |

| Item | description | type | lead time [wks] | Export control | reference | LLI procurement | | first need milestone |
|-------------------------|---|---------------|--|-------------------|--|--------------------|-----|--|
| | | | | | | B2 | C/D | |
| Black Target | aluminum, Black anodizing | | 4 + 2 (manufacturing & coating) + 1 bake-out | No | | | X | EQM Rotor Integration (FM w/o bake-out) FM for PFM Sun Diffuser Integration |
| position sensors | Hall Effect Sensor, Uni-Polar, non-latching, space grade Manufacturer: OPTeK | OMH090S | 19 - 21 | EAR99 | Swissdis AG quote 05.05.2017 ALM-ACH-3073 | | X | COTS for CUIS Integration (same manufacturer as FM) FM for EQM Drive System Integration |
| Microswitch | Baumer Spacegrade switch by RUAG | MY-COM B75/80 | 4 | no | ALM-ACH-2880 | | X | COTS for CUIS Integration (same manufacturer as FM) FM for EQM Drive System Integration |
| Thermistors | thermal sensor | PT1000 | 10 | no | ALM-ACH-3050 | | X | COTS for CUIS Integration (same manufacturer as FM) |

| Item | description | type | lead time [wks] | Export control | reference | LLI procurement | | first need milestone |
|------------------------------|--|--------------------------------------|--------------------|-------------------|---------------------|--------------------|-----|--|
| | | | | | | B2 | C/D | |
| mirror cube | Removable aluminium cube. 1x1x1in Manufacturer: Kugler-Precision TBC | 1-9-182-00-001-k.1 | 15 - 17 | No | IOMS-R (Sentinel-5) | | X | FM for EQM Rotor Integration EQM Baffle Integration |
| flight connectors | C&K connectors | DAM15P, DBM44S with savers & caps | 10 | No | | | X | FM for CUIS (or commercial with flight savers) |
| Wiring | wiring for CU & TVAC harness | Axon | 8 | | | | X | EQM Drive System Integration start |
| screws (flight) | Titanium fastners and washers | different type | 16 wks | no | | | X | Flight for EQM Baffle Assembly start |
| helicoils | | different type | 4 to 12 wks | no | ALM-ACH-3099 | | X | Flight for EQM Baffle Assembly start |