

Future Launchers Preparatory Programme

Delegaci do Rady Programowej PB - LAU

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Future Launchers Preparatory Programme

Programme Future Launchers Preparatory Programme		Components Core Ultra Low Cost Engine Demonstrator, LOx-Methane test bench		
Financial Envelope Core: M€ 273.3 Ultra Low CED: M€ 100 LOx-Methane: M€ 10	Economic Conditions Core: 2012 Ultra Low CED: 2016 LOx-Methane: 2016	Acronym FLPP	Phase / Time frame Period 3 NEO (2017-2019)	Threshold Core: 60% Ultra Low CED: 60% LOx-Methane: 60%

Participating States		FLPP Period 3/NEO Core Component M€		FLPP Period 3/NEO Ultra Low Cost Engine Demonstrator Component M€	FLPP Period 3/NEO LOx-Methane Component M€
AT	Austria	2.17	+ 1.72	3.89	
BE	Belgium	12.20	+ 10.24	22.44	2.00
CZ	Czech Republic	2.69	+ 9.39	12.08	
DK	Denmark	2.93	+ 0.94	3.87	
FR	France	1.00	+ 2.82	3.82	63.00
DE	Germany	65.26	+ 36.18	101.44	9.12
IE	Ireland	4.30	+ 0.94	5.24	
IT	Italy		+ 0.94	0.94	5.00
NL	Netherlands	4.20	+ 9.39	13.59	
NO	Norway	4.00	+ 7.51	11.51	
PL	Poland		+ 3.75	3.75	
PT	Portugal		+ 0.28	0.28	
RO	Romania	5.32	+ 17.84	23.16	
ES	Spain	3.13	+ 2.97	6.10	
SE	Sweden	18.72	+ 3.29	22.01	3.00
CH	Switzerland	6.75	+ 2.82	9.57	0.50
Covered		132.67	+ 111.02	243.69	82.62
Uncovered		140.63	- 111.02	29.61	17.38
TOTAL		273.30		273.30	100.00
					6.00
					4.00
					10.00

Work Plans for FLPP Period-3/NEO

- Section 2: Work plan of the Core Component on Hybrid Propulsion
- Section 3: Work plan of the Core Component for Green Bi-propellant Propulsion activities
- Section 4: Work plan of the Core Component for valve and turbine technology activities in support of liquid propellant engines
- Section 5: Work plan of the Core Component for Space Transportation system investigation
- Section 6: Work plan of the Core Component for advanced manufacturing technologies for low cost Engine Thrust Frame
- Section 7: Work plan of the Core Component for preliminary studies on launch services making use of a micro-launcher

Work plan of the Core Component on Hybrid Propulsion

The activities will be organised around the following areas :

- Consolidation of the propulsion specifications as per launcher system analysis
- Further design improvements of the technologies matured on UM1 (Unitary Motor)
- Maturation of additional technologies in view of an application on UM2
- Design, manufacturing and testing of the UM2 demonstrator
- Preparation of an industrial file, interaction with potential microlauncher initiatives

The output of this work plan will be the TRL 6 demonstration (hot-fire tests) of a very low cost hybrid motor, as a competitive propulsion solution for a European microlauncher.

Considering that the proposed activities are in continuation of on-going advanced tasks in hybrid propulsion, it is planned to proceed with the same contractor Nammo (NO) under a contract rider.

Work plan of the Core Component for Green Bi-propellant Propulsion activities

An objective and exhaustive trade-off will be performed on the propellants, against a clear set of criteria. A high rank will be given to criteria such as costs in operations, very long duration storability, ignitability and combustion stability, among others. A priori, possible oxidizers could be H₂O₂ or LOx (any other to be seen on a case-by-case basis), and possible fuels could be ethanol or kerosene (any other to be seen on a case-by-case basis).

Activities	AT	BE	CZ	CH	DE	DK	ES	FR	IE	IT	NO	NL	RO	PL	PT	SE
<u>Propulsion</u>																
<u>Green Propellants Propulsion</u>			⊕	⊕	⊕		⊕					⊕		⊕		

The proposed activities will be an evolution toward green propellants of the former FLPP storable propulsion demonstrator. Therefore the proposed procurement approach is with the same prime contractor ASL GmbH Ottobrunn (DE), in order to benefit directly from essential intellectual property and assets. In agreement with this prime contractor, subcontracts may be placed in Czech Republic for electropump technologies and in Poland for high grade H₂O₂, if justified by the technical evolution of the activities. Former activities of Franke in Switzerland on low cost nozzle skirt may also be continued.

Work plan of the Core Component for valve and turbine technology activities in support of liquid propellant engines

For what concerns valves, the topics are :

- Sealing technology (in particular for methane)
- Additive manufacturing for valves
- Materials
- Ultra low cost valve electric actuators
- Electronic Valve Controller Unit : design for ultra low cost in production
- Low cost electrovalves

For what concerns turbine, the topics are :

- Additive manufacturing, sample tests, destructive inspections, printing of turbine samples, inspections
- Characterisation in gaseous methane
- Turbine blade profile trade-off cost / performance (robustness)
- Cycling tests (reusability)
- Bearing technology

Work plan of the Core Component for valve and turbine technology activities in support of liquid propellant engines

The proposed procurement approach is in line with the industrial set-up considered for the Ultra Low Cost Engine Demonstrator. The valve technology activities are proposed to be placed in direct contract with Safran Aero Boosters in Belgium. The turbine technology activities are proposed to be placed directly with GKN Aerospace in Sweden.

Activities	AT	BE	CZ	CH	DE	DK	ES	FR	IE	IT	NO	NL	RO	PL	PT	SE
Propulsion																
<u>Valve & Turbine Technologies for Liquid Propulsion</u>		⊕														⊕

The proposed procurement approach is in line with the industrial set-up considered for the Ultra Low Cost Engine Demonstrator. The valve technology activities are proposed to be placed in direct contract with Safran Aero Boosters in Belgium. The turbine technology activities are proposed to be placed directly with GKN Aerospace in Sweden.

Work plan of the Core Component for Space Transportation system investigation

The following elements are proposed, as part of the system activities for the NEO Phase :

- *Launcher and Propulsion system*
- *Technology Development and Verification Plan (TDVP)*
- *Requirements elaboration*
- *RLS (Reusable Lower Stage)*
- *Overall trends in technology and innovation*
- *Injection and De-orbiting*

Activities	A	B	Cz	CH	D	Dk	E	F	Irl	IT	N	NL	RO	PL	PO	SE
<u>System engineering</u>																
<u>System analysis</u>								⊕								
<u>Subscale System concept investigation</u>			⊕					⊕					⊕			

Work plan of the Core Component for advanced manufacturing technologies for low cost Engine Thrust Frame

As stated in the FLPP Period NEO revised Declaration one general objective of FLPP NEO is to develop a portfolio of Flagship Demonstrators and associated technologies to ensure short Time to Market of price competitive innovations.

The proposed activities are focused on panels been forming manufacturing technology maturation in view of engine thrust frame cost decrease associated with Industry 4.0 integrated manufacturing validation in support of European launcher competitiveness.

Activities	A	B	Cz	CH	D	Dk	E	F	IrI	IT	N	NL	RO	PL	PO	SE
Advanced Technologies																
Structure/Material and Processes Themes																
<u>Low Cost Engine Thrust Frame technology</u>												⊕				

ESA intended approach

Contracting out to European economic operators parallel studies on launch services making use of a micro-launcher developed & manufactured (at least at prime level) and operated from territory under European jurisdiction

Main criteria

- 1) Commercial viability/business case: demonstration of economically sustainable launch services
- 2) Proposed concept with enabling innovative technologies/processes
TRL \geq 3

ESA ITT in open competition Summer 2017

Potential follow-on contractual phase to fund innovative/enabling technologies among phase 1 contractors

Micro-launcher in ESA portfolio

- **Phase 1: Assessment**
- **An open ITT shall be issued by FLPP during summer 2017**
- **The evaluation criteria for Phase 1 contract award (included in the Special Condition of Tender) will allow for the assessment of the credibility of the business case and of the technical concept**
- FLPP funding of technology development/maturation activities only in Phase 2, selected among Phase 1 participants
- Results of already performed similar studies made available free of charge to ESA, can be considered for phase 2 technology support.
- European teaming-up is welcome

- **Phase 2: Development and technology support**
- Based on the study results, integration of selected technologies in the ESA technology portfolio for maturation (mainly FLPP roadmaps, ca. 30M€/Y)
 - ESA will only fund maturation of **critical technologies (no development/exploitation)**
 - ESA will only fund industries in States participating to relevant ESA Programmes