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Abstract #XXX

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### Title

## RELIANCE, an electric pump-fed main engine for ESA's lunar lander

### Authors

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### Abstract

Over the past 3 years and within the framework of the European Exploration Envelope Programme (E3P) of the European Space Agency (ESA), Nammo (UK, Norway) has been developing a new type of high performance and high capability bi-propellant rocket engine to enable planetary landings and other ambitious European exploration missions[1]. Its first application is intended to be as main onboard propulsion for ESA's European Large Logistics Lander (EL3), recently renamed Argonaut, which targets a first mission to the Moon's surface in 2030.

RELIANCE is a MON/MMH hypergolic liquid rocket engine, with 6 kN of vacuum thrust at nominal, which aims to deliver both high performance, with specific impulse over 330 seconds at nominal thrust, and a large throttleability range from 3 to 7 kN. Both high performance and deep throttleability are needed to enable planetary landings on the Moon, Mars and beyond in future European exploration missions and as such this engine is an important element in ESA's exploration roadmap.

These features are made possible by multiple new technological blocks, including electric propellant pumps and controllers, dual-cooled regenerative chamber built using additive manufacturing and a pintle injector. Nammo are currently collaborating with multiple European organisations at component and sub-system level in order to deliver RELIANCE to the future lunar lander Prime.

In October 2022, Nammo passed the Baseline Design Review (BDR) for RELIANCE, providing a first comprehensive view of the flight engine system design, its development plan, and industrial consortium. This article will present the BDR design of RELIANCE and the main results from this review. It will discuss the current specification, the ongoing design trade-offs and the future developments steps in this novel European engine development programme.

### References

[1] RELIANCE, A THROTTLEABLE AND E-PUMP-FED BI-PROPELLANT ENGINE FOR EXPLORATION MISSIONS, Boiron et al., SP2022\_146, Space Propulsion Conference, Estoril, Portugal 2022