DESIGN DOSSIER — REV B — FEB 2026

LUNA-AEGIS SHUTTLE “SHORT HOPPER”

REUSABLE LUNAR SURFACE–ORBIT TRANSFER VEHICLE

Design Authority: Aegis Station Infrastructure LLC

Status: Concept – Feasibility Ready

Export: ITAR/EAR-Free Baseline

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01 — MISSION OVERVIEW

The Luna-Aegis Short Hopper is a reusable single-stage VTOL lunar shuttle designed for rapid transfer between Aegis Station in low lunar orbit and surface sites near the Moon’s south pole. Operating on ISRU-compatible LOX/LHI propellants with a single gimbaled vacuum engine, it supports crew, cargo, and hybrid missions across a 1,500–2,000 km surface range.

With a gross wet mass of ~8,000 kg and a design Δv of 1,800 m/s (including 10% margin), the architecture is optimized for one-way hops with ISRU refueling at destination, enabling full lunar surface access via staged operations.

Key attributes: VTOL, single-stage, ISRU-compatible, fully reusable, autonomous-capable, Artemis-compatible.

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02 — TECHNICAL SPECIFICATIONS

Physical

- Total Height: ~6.5 m
- Landing Zone Diameter: ~4.5 m
- Gross Wet Mass: ~8,000 kg
- Dry Mass: ~5,250 kg
- Propellant Mass: ~2,750 kg (34.4% mass fraction)

Propulsion

- Propellants: LOX / LHI (ISRU-compatible)
- Engine: Single gimbaled vacuum engine
- Thrust (vac): ~25–30 kN

- Specific Impulse: 430–450 s
- T/W at Lunar Liftoff: ~1.9–2.3
- Design Δv: 1,800 m/s (10% margin)
- Mission Δv Range: 1,600–1,700 m/s per one-way hop
- Attitude Control: Engine gimbal + RCS thrusters

Performance

- Surface-to-Surface Range: 1,500–2,000 km
- Surface-to-LLO: Yes (with ISRU refuel at surface node)
- Reusability: Minimum 5–10 sorties; indefinite with proactive maintenance
- Turnaround Time: 24–48 hours (with LUNET node support)
- Landing Precision: ±3 m (nominal)

Crew & Cargo

- Crew Capacity (standard): 4
- Crew Capacity (max, reduced range): 6
- Cargo Capacity: Up to 1,000 kg
- Operational Duration (crewed): 72–96 hours

Avionics & Systems

- Flight Computers: Dual-redundant radiation-hardened
- Navigation: FOG/RLG IMU + MEMS backup, Kalman fusion, lidar/radar altimeter
- Landing Guidance: Terrain-relative navigation; LUNET beacon alignment
- Communications: S-band/UHF + high-gain directional
- Power: Rechargeable battery packs + passive solar backup
- Life Support: Pressurized cabin; Orion-class LSS heritage
- Docking Interface: Aft/lower hatch with soft-seal telescoping collar

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03 — CABIN CONFIGURATIONS

Config A — Crew (4 / 6 crew)

Full pressurized cabin with airlock and suits. 72–96 hr LSS. Direct suitport mate with Aegis-Class Rover. Emergency portable air systems.

Config B — Cargo (1,000 kg)

Palletized cargo with latch-and-lock mounts. Supports ISRU tanks, EVA gear, small rovers, sample return payloads. Optional robotic assist arm.

Config C — Hybrid (2 crew + ~500 kg)

Mixed crew and logistics. Supports medical evacuation, science payload delivery, and priority crew + equipment transfers between surface nodes.

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04 — PROPULSION & MASS BUDGET

A single gimbaled LOX/LHI vacuum engine (~25–30 kN) is mass-efficient and mechanically simpler than a multi-engine cluster at this scale. At 8,000 kg wet mass, lunar liftoff weight is ~13 kN, giving a T/W of ~1.9–2.3 at ignition. Engine gimbal provides pitch/yaw authority; RCS handles roll and fine station-keeping.

One-way hop architecture with ISRU refueling enables full lunar surface access. Round-trip without refueling requires ~4,360 kg propellant, pushing wet mass to ~9.5 t; therefore one-way + ISRU is the preferred baseline.

Performance Summary:

- Vacuum Thrust: ~30 kN
- Isp: ~440 s
- Design Δv: 1,800 m/s
- Lunar T/W: ~2.1×

Mass Budget (8,000 kg wet)

- Propellant: ~2,750 kg (34.4%)
- Structure / Tanks: ~2,110 kg (26.4%)
- Cabin / LSS / Payload: 1,055 kg (13.2%)
- Propulsion System: ~790 kg (9.9%)
- Landing Gear: ~527 kg (6.6%)
- Avionics / GN&C: ~422 kg (5.3%)
- Mass Margin (7%): ~369 kg (4.6%)

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05 — LANDING, AUTONOMY & INTERFACES

Landing System

- Four fixed legs with thermal shielding and dust-tolerant footpads
- Terrain-relative navigation (lidar + radar altimeter)
- FOG/RLG IMU with MEMS backup; Kalman fusion with abort capability
- LUNET beacon alignment for ±3 m precision
- Operable in permanently shadowed regions
- Redundant onboard nav logic; autonomous flight, landing, and re-docking

Interfaces & Integration

- Soft-docking collar compatible with Aegis Station, surface habs, and Aegis-Class Rover suitport
- Pressurized telescoping tunnel with dust seals (no EVA required)
- Cryogenic refueling via LUNET-compatible cartridge port
- Palletized cargo latch-and-lock; optional robotic assist arm
- Field diagnostics via rover interface or LUNET node terminal
- Modular avionics and structural interfaces for rapid field swap

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06 — DEVELOPMENT ROADMAP & STATUS

2026: Preliminary Design Review (PDR)

2027: Subsystem demos & Critical Design Review (CDR)

2028: Flight prototype build

2029+: Qualification flight & operations

Work Packages (Open for Partnership)

- Cryogenic propulsion system
- Avionics & GN&C
- Cabin & life support systems
- Landing gear & tank modules

The Short Hopper is available for feasibility collaboration, licensing, lunar mobility adaptation, and partnerships with ISRU and infrastructure developers.

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