Luna–Aegis Shuttle Dossier

Short-Hop Lunar Shuttle for Surface–Orbit Transfers

1. Overview

The **Luna–Aegis Shuttle**—informally the **"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. It supports both crew and cargo missions, with a compact profile, autonomous landing capability, and modular cabin configurations.

2. Mission Profile

- Transport astronauts, cargo, and lunar samples between Aegis Station and the surface
- Enable direct crew transfer to/from Aegis-Class Rover without EVA
- Operate in rugged terrain and permanently shadowed regions (PSRs)
- Support long-range surface hops (1,500–2,000 km) between surface nodes
- Provide a reusable logistics backbone for station servicing, ISRU transport, and science payload delivery

3. Key Features

- Vertical takeoff and landing (VTVL) configuration
- Autonomous or optionally crewed operation modes
- Pressurized cabin with airlock and docking system
- Four-legged landing gear with dust-tolerant footpads
- Direct integration with Aegis-Class Rover suitport or airlock
- Cryogenic LOX/LH_2 propulsion (ISRU-compatible)
- Fully autonomous flight, landing, and re-docking
- Modular design: Crew-only, cargo-only, or hybrid configurations

4. Technical Specifications

Parameter	Value / Estimate
Crew Capacity	2–6 astronauts (modular cabin)
Cargo Capacity	Up to 1,000 kg
Total Height	~6.5 meters
Diameter (Landing Zone)	~4.5 meters
Propellants	LOX / LH_2
ISP (Vacuum)	370–450 seconds
Delta-v (per hop)	1.6–1.7 km/s
Reusability	Minimum 5–10 sorties per vehicle; potentially indefinite with proactive maintenance and subsystem replacement.
Flight Range	1,500–2,000 km
Operational Duration	72–96 hours (crewed missions)
Atmosphere	O_2/N_2 mix (standard lunar cabin)
Docking Interface	Aft or lower hatch; soft-seal mate

5. Docking & Payload Transfer

- Soft-docking interface compatible with Aegis-Class Rover and surface habs
- Pressurized telescoping collar or tunnel with dust seals
- Robotic assist arm (optional) for cargo transfer
- Palletized cargo mounts with latch-and-lock system
- Supports ISRU tanks, EVA gear, small rovers/drones, sample return payloads

6. Landing & Autonomy

- Four fixed landing legs with thermal shielding and adaptive footpads
- Terrain-relative navigation with lidar and radar altimeter

- High-accuracy FOG or RLG IMU with MEMS backup
- Redundant onboard nav logic with Kalman fusion and abort capability
- Node-assisted landing: compatible with LUNET beacon alignment systems
- Landing precision: ±3 meters (nominal)

7. Avionics & Power

- Dual-redundant radiation-hardened flight computers
- Rechargeable battery packs with passive solar backup
- Communications:
  - S-band/UHF for short-range ops
  - High-gain directional antenna for station uplink

8. Life Support System

- Duration: 72–96 hours
- Atmosphere: Pressurized O_2/N_2 mix
- Systems: Derived from Orion-class architecture
- Emergency: Portable air systems and rapid egress support

9. Interfaces & Interoperability

- Compatible with Aegis Station, surface habs, rovers
- Cryogenic refueling via LUNET-compatible cartridge port
- Robotic arm-ready loading/unloading system
- Modular avionics and structural interfaces for rapid field swap

10. Operations & Maintenance

- Turnaround time: 24–48 hours with LUNET node support
- Fully autonomous flight profile
- Field diagnostics via rover interface or node
- Maintenance: Replaceable avionics, tanks, nav sensors

11. Development & Manufacturing

- Design Authority: Aegis Station Infrastructure LLC (ASI)
- Execution: All fabrication/integration via subcontractor network
- Major work packages:
  - Cryo propulsion [TBD]
  - Avionics and GN&C [TBD]
  - Cabin systems [TBD]
  - Landing/tank modules [TBD]

12. Compliance & Roadmap

- Export Control: ITAR/EAR-free baseline architecture
- Designed for compatibility with Artemis logistics and STMD priorities
- Milestones:
  - PDR: Target 2026
  - Subsystem demos: 2027
  - Flight prototype: 2028

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