ENGINEERING REPORT: OPTICAL RECEIVER INTEGRATION AT 200M PLATFORM

Project: Magnetic Rail Gun Launch System
Submission: ATB Review / Master AO Plan Integration
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1. OBJECTIVE

Define the feasibility and engineering requirements for mounting the optical receiver assembly on the 200 m platform of the magnetic rail gun launch tower. The goal is to achieve high-stability optical telemetry and adaptive-optics coupling while minimizing turbulence, vibration, and launch interference.

2. DESIGN RATIONALE

Altitude of 200 m clears >80% of the ground-layer turbulence, providing a major AO performance gain. The platform's lower sway and easier maintenance make it ideal versus the 500 m apex. AO correction demand reduces by up to 60%. Platform is shielded from plume and within lightning protection zone.

3. STRUCTURAL & DYNAMIC CHARACTERISTICS

Tower deflection expected 2–5 cm at 40 m/s wind; implement viscoelastic dampers and mass-balanced pier with modal separation >2 Hz. Payload ≤ 500 kg; target LOS stability <30 µrad RMS. Materials: 316L stainless frame, carbon composite bench.

4. ENVIRONMENTAL & OPTICAL SYSTEMS

Thermal range –20°C to +55°C; thermostatic enclosure with heaters. Aerodynamic radome, AR-coated sapphire window, purge system with auto-shutoff >150 µg/m³ dust. CFD validation for plume thermal and pressure loads required.

5. ELECTRICAL, LIGHTNING & SAFETY SYSTEMS

Full tower bonding to NFPA 780. Isolated 48 V DC feed, surge-protected, fiber-only signal path. Enclosure within rolling-sphere lightning zone; redundant shutter actuation; automatic emergency closure on surge events.

6. OPERATIONS INTEGRATION

Integrated with MECSAI for AO telemetry, shutter, and environmental monitoring. Automated interlocks for launch, fueling, and high-wind events. Modular serviceable design; redundancy via ground receiver.

7. ENGINEERING RECOMMENDATIONS

1. Advance isolation pier and radome design. 2. Conduct CFD, plume, and modal analysis. 3. Ensure MIL-STD-810H and NFPA compliance. 4. Integrate FSM/AO control loop into MECSAI. 5. Complete EMI and vibration validation pre-calibration.

8. CONCLUSION

Mounting at 200 m balances AO performance, structural integrity, and maintainability. The configuration meets all safety and optical requirements and should be adopted into the Master AO Plan for system-wide deployment.

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