ROBOT PERFORMANCE SPECIFICATIONS

MedCold Storage Facilities

Document No. PDR-SPEC-2023-MC-147

Effective Date: January 15, 2024

1. GENERAL PROVISIONS

1 This Performance Specification Document ("Specification") sets forth the minimum operational requirements and performance standards for Polar Dynamics Robotics, Inc.'s ("PDR") autonomous mobile robots deployed in medical-grade cold storage facilities ("MedCold Facilities").

2 These specifications apply to PDR's IceNav(TM)-enabled autonomous mobile robots, specifically models MC-500, MC-750, and MC-1000 (collectively, "Units"), when operating in controlled temperature environments between -30 C and +5 C.

2. DEFINITIONS

1 "Operating Environment" means any FDA-compliant cold storage facility maintaining temperature-controlled conditions for medical products, pharmaceuticals, or biological materials.

2 "Performance Cycle" means a continuous operational period of up to 12 hours during which a Unit performs its designated functions.

3 "Critical Failure" means any malfunction that results in (i) deviation from prescribed navigation paths by more than 50mm, (ii) temperature control variance exceeding 0.5 C, or (iii) handling errors affecting payload integrity.

3. OPERATIONAL REQUIREMENTS

1 Temperature Tolerance

a) Units shall maintain full operational capability in ambient temperatures from -30 C to +5 C

b) Internal components must remain within specified operating ranges per PDR Engineering Standard ES-227

c) Thermal management systems shall prevent condensation on critical sensors and electronics

2 Navigation Precision

a) Path accuracy: 25mm in standard operating conditions

b) Position repeatability: 10mm at pickup/dropoff points

c) Obstacle detection and avoidance: 99.99% reliability rate

d) Emergency stop function: <100ms response time

3 Payload Specifications

a) Maximum capacity: 750kg (MC-500), 1,000kg (MC-750), 1,500kg (MC-1000)

b) Handling precision: 2mm vertical alignment

c) Acceleration limits: 0.5 m/s with payload

d) Vibration dampening: 0.1g RMS during transport

4. PERFORMANCE STANDARDS

1 Operational Reliability

a) Minimum uptime: 98% during scheduled operation periods

b) Mean Time Between Critical Failures (MTBCF): 2,000 hours

c) Battery life: 12 hours continuous operation at full load

d) Charging cycle: 45 minutes to 90% capacity

2 Safety Compliance

a) Emergency stop systems: ISO 13849-1 Performance Level D

b) Wireless communication: FDA 21 CFR Part 11 compliant

c) Materials: FDA-approved for clean room environments

d) EMC compliance: IEC 61000-6-2 for industrial environments

5. MONITORING AND REPORTING

1 Each Unit shall maintain continuous logging of:

a) Operating temperature (internal and external)

b) Navigation parameters and deviations

c) Payload handling metrics

d) System diagnostics and error states

2 Data Retention

a) Minimum 90-day onboard storage of operational data

b) Secure transmission to PDR cloud infrastructure every 60 seconds

c) Automated alerts for out-of-specification conditions

6. MAINTENANCE REQUIREMENTS

1 Preventive Maintenance

a) Scheduled inspection intervals: 500 operating hours

b) Calibration checks: Monthly

c) Software updates: Minimum quarterly or as critical updates available

2 Component Replacement

a) Critical components: Replacement at 80% of rated life

b) Wear items: Per PDR Service Bulletin SB-2023-MC-12

7. WARRANTY AND LIMITATIONS

1 Performance specifications herein are warranted under normal operating conditions as defined in PDR Operating Manual OM-MC-2023.

2 Specifications subject to deviation in cases of:

a) Power supply fluctuations exceeding 5%

b) Electromagnetic interference above specified thresholds

c) Physical obstruction of navigation sensors

d) Unauthorized modification of system parameters

8. CERTIFICATION

These specifications are certified compliant with FDA 21 CFR Part 11, ISO 13849-1, and applicable GMP requirements for medical storage facilities.

POLAR DYNAMICS ROBOTICS, INC.

By: _

Dr. James Barrett

Chief Robotics Officer

Date: _

Document Control: PDR-SPEC-2023-MC-147-R1

Classification: Confidential and Proprietary