REAL-TIME MONITORING SYSTEM DESIGN SPECIFICATION

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Classification: CONFIDENTIAL

1. INTRODUCTION

1 This Real-time Monitoring System Design Specification ("Specification") is issued by Polar Dynamics Robotics, Inc., a Delaware corporation ("Company"), and sets forth the technical and operational requirements for the IceNav(TM) Real-time Monitoring System ("System") implemented across the Company's autonomous mobile robot ("AMR") fleet.

2 This Specification shall be interpreted in conjunction with the Company's Master System Architecture Documentation (Doc. Ref: PDR-MSA-2023-005) and Technical Operating Procedures (Doc. Ref: PDR-TOP-2023-012).

2. SYSTEM OVERVIEW

1 The System provides continuous monitoring and data collection for AMR units operating in temperature-controlled environments ranging from +25 C to -40 C, incorporating:

a) Real-time telemetry acquisition

b) Environmental condition monitoring

c) Performance metrics tracking

d) Predictive maintenance indicators

e) Safety system status monitoring

2 The System utilizes the Company's proprietary ColdSense(TM) sensor array and ThermalGuard(TM) monitoring protocols to ensure reliable operation in extreme temperature conditions.

3. TECHNICAL SPECIFICATIONS

1 Data Collection Parameters

The System shall monitor and record the following parameters at intervals not exceeding 100 milliseconds:

a) Ambient temperature (0.1 C precision)

b) Internal component temperatures

c) Motor torque and current draw

d) Actuator positions and loads

e) Navigation sensor data streams

f) Battery thermal characteristics

g) System voltage levels

h) Network connectivity status

2 Processing Requirements

The System shall maintain:

a) Maximum latency of 50ms for critical parameters

b) Data compression ratio of 10:1 for non-critical parameters

c) Local storage capacity of 72 hours of full-resolution data

d) Real-time analysis of 250+ concurrent data streams

e) Automated fault detection and classification

4. SAFETY AND REDUNDANCY

1 The System shall implement triple-redundant monitoring for all safety-critical parameters.

2 Failover Requirements:

a) Automatic switchover to backup sensors within 10ms

b) Independent power supply for monitoring circuits

c) Redundant data storage with geographic distribution

d) Fault-tolerant network communication protocols

5. COMPLIANCE AND CERTIFICATION

1 The System design shall comply with:

a) ISO/IEC 61508 (Functional Safety)

b) EN 61326-1 (EMC Requirements)

c) UL 1998 (Software in Programmable Components)

d) FDA 21 CFR Part 11 (where applicable for pharmaceutical environments)

2 All monitoring components shall maintain certification for operation in Class 1, Division 2 hazardous locations per NFPA 70.

6. DATA MANAGEMENT AND SECURITY

1 The System shall implement:

a) AES-256 encryption for all data in transit and at rest

b) Role-based access control with multi-factor authentication

c) Automated audit logging of all system interactions

d) Secure API endpoints with token-based authentication

e) Data retention policies compliant with 21 CFR Part 11

2 All collected data shall remain the exclusive property of the Company and/or its designated customers pursuant to applicable service agreements.

7. MAINTENANCE AND UPDATES

1 The System shall support:

a) Remote firmware updates with rollback capability

b) Hot-swappable monitoring modules

c) Automated calibration verification

d) Diagnostic self-test routines

e) Configuration version control

2 System maintenance shall not require AMR operational shutdown except for physical sensor replacement.

8. PROPRIETARY RIGHTS

1 This Specification contains confidential and proprietary information of the Company and is

protected under applicable intellectual property laws.

2 No part of this Specification may be reproduced, modified, or distributed without the express written consent of the Company's Chief Technology Officer or General Counsel.

9. APPROVAL AND EXECUTION

IN WITNESS WHEREOF, this Specification has been reviewed and approved by the undersigned authorized representatives of the Company:

APPROVED BY:

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Marcus Chen

Chief Technology Officer

Date: January 11, 2024

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Dr. James Barrett

Chief Robotics Officer

Date: January 11, 2024

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Katherine Wells

Chief Financial Officer

Date: January 11, 2024