

CHARGING STATION INTEGRATION GUIDE

Polar Dynamics Robotics, Inc.

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1. INTRODUCTION AND SCOPE

1. This Charging Station Integration Guide ("Guide") is a controlled document issued by Polar Dynamics Robotics, Inc. ("PDR") governing the technical and operational requirements for integrating charging stations with PDR's IceNav-enabled autonomous mobile robots ("AMRs").
2. This Guide applies to all Model ICE-750 and ICE-1000 series AMRs operating in temperature-controlled environments ranging from -40 C to +25 C.

2. DEFINITIONS

1. "Charging Infrastructure" means the complete assembly of charging station hardware, power distribution units, and associated control systems.
2. "Cold Zone Certification" refers to PDR's proprietary validation process for charging equipment operating in sub-zero environments.
3. "Thermal Management Protocol" or "TMP" means PDR's standardized procedure for managing charging thermal loads in extreme temperature conditions.

3. TECHNICAL SPECIFICATIONS

1. Power Requirements
 - a) Input Voltage: 380-480V AC, 3-phase
 - b) Maximum Current Draw: 63A per charging point
 - c) Power Factor: >0.95 at nominal load
 - d) Efficiency: 94% at rated power
2. Environmental Parameters
 - a) Operating Temperature Range: -40 C to +45 C

- b) Humidity: 5% to 95% non-condensing
- c) IP Rating: IP65 minimum for external components
- d) NEMA Rating: Type 4X for enclosures

4. INSTALLATION REQUIREMENTS

1. Physical Installation

- a) Minimum clearance of 1000mm on all sides
- b) Floor loading capacity: 2500kg/m
- c) Mounting height: 1200mm 50mm from finished floor level
- d) Cable management system compliant with PDR specification PS-CM-2023-R2

2. Safety Systems

- a) Emergency stop integration with facility E-stop network
- b) Thermal runaway detection system
- c) Arc flash protection compliant with NFPA 70E
- d) Integrated fire suppression system for enclosed charging areas

5. COMMUNICATION PROTOCOLS

1. Required Protocols

- a) TCP/IP (IPv6 ready)
- b) CAN bus (ISO 11898-2:2016)
- c) Modbus TCP
- d) PDR proprietary IceNav Communication Protocol v3.2

2. Network Security

- a) TLS 1.3 encryption minimum
- b) Certificate-based authentication
- c) Role-based access control
- d) Secure boot verification

6. OPERATIONAL PROCEDURES

1. Pre-charging Verification

- a) Thermal status check
- b) Contact resistance measurement
- c) Insulation verification
- d) Environmental parameter validation

2. Charging Process Control

- a) Dynamic current adjustment based on temperature
- b) Automated thermal management
- c) State of charge monitoring
- d) Fault detection and response

7. MAINTENANCE AND INSPECTION

1. Scheduled Maintenance

- a) Monthly visual inspection
- b) Quarterly thermal imaging
- c) Semi-annual power quality analysis
- d) Annual full system certification

2. Documentation Requirements

- a) Maintenance logs
- b) Calibration records
- c) Incident reports
- d) Performance trending data

8. COMPLIANCE AND CERTIFICATION

1. Required Certifications

- a) UL 2202
- b) CE marking
- c) PDR Cold Zone Certification
- d) ISO/IEC 61851-1

2. Quality Assurance

- a) IEC 61000-6-2 EMC immunity
- b) NRTL listing for North American installations
- c) PDR Quality Management System compliance
- d) Environmental stress testing verification

9. DISCLAIMER AND LIABILITY

1. This Guide contains confidential and proprietary information of PDR. Any unauthorized use, disclosure, or reproduction is strictly prohibited.
2. PDR assumes no liability for charging station integration failures resulting from non-compliance with this Guide.
3. All warranties, express or implied, are subject to the terms and conditions of PDR's Master Service Agreement.

10. DOCUMENT CONTROL

1. This document is maintained by PDR's Technical Documentation Department.
2. Revision History:
 - v2.4 (2024-01-11): Updated thermal management protocols
 - v2.3 (2023-09-15): Added ICE-1000 series specifications
 - v2.2 (2023-06-22): Enhanced network security requirements
 - v2.1 (2023-03-10): Updated compliance requirements

APPROVED BY:

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