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Secure Configuration Management System and Method for Industrial Control Networks

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ABSTRACT

A system and method for secure configuration management of industrial control systems comprising an adaptive security architecture that dynamically validates and enforces configuration policies across distributed operational technology (OT) environments. The invention implements a multi-layered verification protocol utilizing cryptographic signatures, behavioral analysis, and machine learning to detect and prevent unauthorized configuration changes while maintaining operational continuity in critical infrastructure settings.

CLAIMS

A secure configuration management system for industrial control networks, comprising:

a. A centralized policy engine configured to:

- Store approved configuration templates
- Generate cryptographic signatures for validated configurations
- Maintain chain-of-custody records for configuration changes

b. Distributed validation nodes configured to:

- Monitor real-time configuration states
- Execute local policy enforcement
- Report anomalies to the centralized engine

c. An artificial intelligence module configured to:

- Learn normal configuration patterns

- Detect potential security violations
- Recommend remediation actions

The system of claim 1, wherein the centralized policy engine implements:

a. Role-based access control with multi-factor authentication

b. Encrypted configuration storage using AES-256 standards

c. Automated backup and recovery mechanisms

d. Audit logging with tamper-evident records

A method for securing industrial control system configurations, comprising:

a. Establishing a baseline configuration state

b. Continuously monitoring for deviations

c. Validating changes against approved templates

d. Enforcing security policies in real-time

e. Maintaining comprehensive audit trails

DETAILED DESCRIPTION

Background

Industrial control systems face increasing cybersecurity threats from unauthorized configuration changes that can compromise operational integrity. This invention addresses the critical need for secure configuration management in operational technology environments while maintaining system availability and performance.

Technical Implementation

The system implements a hierarchical architecture comprising:

Core Security Layer
- Cryptographic validation engine
- Policy enforcement framework
- Configuration state database
- Real-time monitoring system

Distribution Layer

- Local validation nodes
- Secure communication channels
- Cached policy rules
- Emergency override mechanisms

Intelligence Layer

- Machine learning models
- Behavioral analysis engine
- Anomaly detection system
- Adaptive policy adjustment

Security Features

The invention incorporates multiple security mechanisms including:

Cryptographic Protection

- SHA-256 hashing for configuration integrity
- RSA-4096 signatures for change authorization
- TLS 1.3 for secure communication
- Hardware security module integration

Access Controls

- Multi-factor authentication
- Role-based permissions
- Temporal access limitations
- Emergency access procedures

Audit Capabilities

- Immutable logging
- Chain-of-custody tracking
- Configuration version control
- Compliance reporting

INDUSTRIAL APPLICABILITY

This invention is particularly applicable to:

- Critical infrastructure protection
- Industrial automation systems
- SCADA networks
- Manufacturing operations
- Maritime control systems
- Energy management systems

LEGAL NOTICES

This patent is assigned to DeepShield Systems, Inc. and protected under United States intellectual property law. Any unauthorized use, reproduction, or implementation of the described invention may constitute patent infringement and will be subject to legal action.

Term of Patent: 20 years from filing date

Maintenance Fees Due: Years 4, 8, and 12

CERTIFICATION

I hereby certify that this patent document accurately represents the invention as approved by the United States Patent and Trademark Office.

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