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HIGH-PERFORMANCE BUILDING DESIGN PROFESSIONAL - HBDP EXAM REFRESHER

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LEED AP(BD+C), GSAS CGP, GCP, ISO 14001

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MODULE
18

Controls & Monitoring: Control Strategies

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HIGH-PERFORMANCE BUILDING DESIGN PROFESSIONAL - HBDP EXAM REFRESHER

Control strategies are crucial for managing and engineering systems, ensuring processes operate within predefined parameters. They aim to maintain system stability, optimize performance, and mitigate risk. Control systems can be classified into open-loop and closed-loop systems, with closed-loop systems using feedback to adjust operations.

Learning Objectives +

- Energy Analysis: Envelope, Massing, and Orientation Optimization
- Energy Analysis: Initial Assessment
- Energy Analysis: Ventilation
- Energy compliance modeling
- Indoor and Site Environment: Thermal Comfort
- Indoor and site environments: air quality
- Indoor and Site Environment: Lighting
- Controls and monitoring: Control Hardware
- Controls and Monitoring: Control Strategies

CONTROL STRATEGIES

- Control strategies are crucial for maintaining system stability, optimizing performance, and mitigating risk.
- Control systems are classified into open-loop and closed-loop systems.
- Control strategies are categorized based on their operational approach: feedback control, feedforward control, adaptive control, and predictive control.
- Feedback control is central to closed-loop systems, requiring continuous monitoring and adjustments based on deviations from the desired state.
- Feedforward control anticipates disturbances and adjusts inputs before any deviation.
- Adaptive control adjusts control parameters based on changing conditions over time.
- Predictive control uses system models to forecast future outcomes and optimize performance.
- Choosing the appropriate control strategy depends on system dynamics, process nature, cost considerations, and performance objectives.
- Control strategies are used in industrial automation, financial markets, and healthcare.
- Understanding and implementing the appropriate control strategy is crucial for achieving desired outcomes and sustaining competitive advantage.

ESTABLISHING CONTROL SEQUENCES TO MEET OWNER OBJECTIVES

Understanding Control Sequences

- Control sequences are systematic procedures designed to meet an organization's objectives effectively and efficiently.
- They are crucial in project management, operations, and quality assurance.

Establishing Objectives

- Control sequences should be based on SMART criteria (Specific, Measurable, Achievable, Relevant, Time-bound).
- Clear, measurable objectives are essential for establishing control sequences.

Measurement and Data Collection

- Progress is measured by identifying key performance indicators (KPIs) that serve as benchmarks for success.
- KPIs should be directly linked to the objectives and provide quantifiable data that informs decision-making.





ESTABLISHING CONTROL SEQUENCES TO MEET OWNER OBJECTIVES +

Implementation of Control Mechanisms

- Control mechanisms are tools and procedures to monitor performance and facilitate corrective actions.
- Examples include regular audits, feedback loops, and responsibility assignments.

Evaluation and Adjustment

- The final stage involves evaluating the effectiveness of a control sequence and making necessary adjustments.
- If objectives have not been met, the reasons behind this shortfall should be analyzed.

Continuous Improvement

- Control sequences should evolve in response to changing objectives, market conditions, or technological advancements.
- A culture of continuous improvement, often associated with methodologies like Lean or Six Sigma, encourages organizations to regularly revisit and refine their control sequences.



CONTROL INTEGRATION IN MODERN ENGINEERING

Fundamental Concepts of Control Integration

- Involves harmonization of hardware and software components to achieve desired operational outcomes.
- Primary components include sensors, actuators, controllers, and communication protocols.
- The control loop is formed by forming a control loop: sensing, processing, action, and feedback.

Types of Control Integration

- Simple Control Integration: Direct connections between sensors and actuators via basic controllers.
- Intermediate Control Integration: Use of PLCs to manage multiple sensors and actuators within a system.
- Advanced Control Integration: Encompasses distributed control systems where multiple controllers communicate over a network.



CONTROL INTEGRATION IN MODERN ENGINEERING +

Benefits of Control Integration

- **Increased Efficiency:** Streamlines processes and reduces manual intervention.
- **Enhanced Accuracy:** Allows real-time data processing for more precise control actions.
- **Improved Safety:** Monitors critical parameters and executes safety measures automatically.
- **Scalability and Flexibility:** Can be easily scaled or modified to accommodate changes in production needs or technological advancements.

Challenges in Control Integration

- **System Compatibility:** Different equipment and control systems may use varying communication protocols.
- **Cybersecurity Risks:** As systems become more interconnected, they become susceptible to cyber threats.
- **Complexity of Design:** Developing integrated systems requires a comprehensive understanding of both control theory and the specific operational context.

Future Trends in Control Integration

- **Industrial Internet of Things (IIoT):** Enhances data collection and analytics.
- **Artificial Intelligence and Machine Learning:** Facilitates adaptive learning.
- **Cloud-Based Control Systems:** Provides flexibility and scalability.



INSTRUCTING BUILDING OPERATORS IN SYSTEM FUNCTIONS

Understanding System Functions

- System functions refer to the operational capabilities of various components within a building.
- Each system is designed to fulfill specific tasks contributing to the overall efficiency, safety, and comfort of the facility.

Components of Building Systems

- HVAC system includes thermostats, chillers and boilers, ductwork, and sensors.
- The HVAC system is compared to a human body, with the thermostat making decisions based on temperature inputs, chillers and boilers circulating fluids, and ductwork distributing air.

Instructional Approaches

- Classroom training: Structured learning where instructors present theoretical concepts and engage operators in discussions.
- Hands-on workshops: Enables operators to interact directly with system components to solidify theoretical knowledge.
- Digital learning platforms: Offer self-paced courses and interactive modules for ongoing education.





INSTRUCTING BUILDING OPERATORS IN SYSTEM FUNCTIONS +

Assessment and Feedback

- Quizzes and tests: Evaluate knowledge retention and understanding of key concepts.
- Performance reviews: Assess operators' ability to apply knowledge in practical scenarios.
- Feedback loops: Create opportunities for operators to provide input on instructional methods and materials.



Continuous Learning and Development

- Regular Training Updates: Offer refresher courses and updates on new technologies.
- Mentorship Programs: Pair less experienced operators with seasoned professionals for guidance.
- Industry Conferences: Encourage participation in events to learn about emerging trends and best practices.

ESTABLISHING PROTOCOLS FOR CONTROLS AND MONITORING

Operator Training Requirements

- Operator training is crucial for effective control and monitoring systems.
- Training should cover technical skills, safety protocols, emergency procedures, and regulatory compliance.
- Importance of training is likened to a concert pianist's preparation.
- Training programs should include Initial Training, Regular Refresher Courses, and Simulation-Based Training.
- Assessment and Certification are necessary to ensure competency.

Operating and Maintenance Procedures

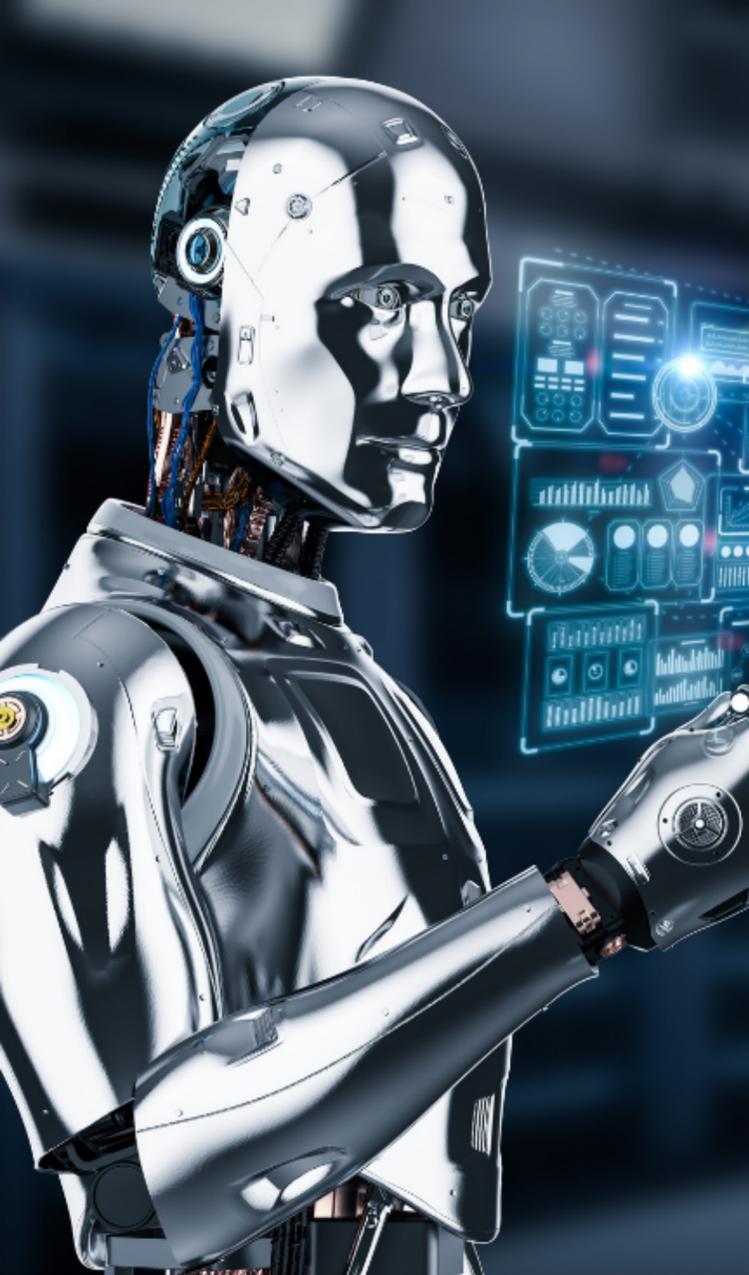
- Standard Operating Procedures (SOPs) guide operators on specific tasks.
- Maintenance protocols include Preventive Maintenance, Predictive Maintenance, and Corrective Maintenance.
- Documentation is essential for identifying patterns and making data-driven decisions.



REPORTING REQUIREMENTS +



- Reporting is a critical component of operational control and monitoring.
- Types of reports include Daily Operational Reports, Incident Reports, and Compliance Reports.
- Effective reporting relies on clear and standardized formats.
- Feedback mechanisms should be incorporated into the reporting process for continuous improvement.



INCORPORATING ENERGY REPORTING CAPABILITIES INTO CONTROLS AND MONITORING

Understanding Energy Reporting

- Energy reporting involves systematic collection, analysis, and presentation of data related to energy consumption.
- Key components include data acquisition, data analysis, and reporting.

Controls and Monitoring Systems

- Controls and monitoring systems are integral to managing and optimizing energy use.
- Controls adjust equipment operation based on real-time data inputs.
- The effectiveness of these controls can be significantly enhanced when integrated with robust energy reporting capabilities.

Monitoring for Continuous Improvement

- Monitoring refers to the ongoing observation of energy consumption and system performance.
- By tracking energy use, organizations can identify inefficiencies, detect equipment malfunctions, and assess the impact of energy-saving initiatives.



INCORPORATING ENERGY REPORTING CAPABILITIES INTO CONTROLS AND MONITORING +

Integrating Energy Reporting into Controls and Monitoring

- Real-time Dashboards: Display energy consumption data alongside operational metrics for quick assessment and adjustments.
- Automated Alerts: Notify users of abnormal energy consumption patterns.
- Performance Benchmarking: Facilitate benchmarking against industry standards or internal targets.
- Feedback Loops: Establish feedback loops between energy reporting and control systems to enhance energy-saving initiatives.

Real-World Examples

- Smart Buildings: Energy reporting capabilities are embedded within the building management system.
- Manufacturing Facilities: Submetering strategy to track energy usage across different production lines.



OPTIMIZING CONTROL SEQUENCES FOR ENERGY CONSERVATION



Understanding Control Sequences

- Control sequences are predefined algorithms that dictate the operational state of a system over time.
- They are found in HVAC systems, lighting, industrial machinery, and energy management systems.
- Open-loop control operates without feedback, while closed-loop systems use feedback to adjust operations dynamically.



The Importance of Optimization

- Optimization is essential for minimizing energy consumption and operational costs while maximizing comfort and performance.
- Primary goals include reducing peak demand, improving system responsiveness, and improving equipment lifespan.

Methodologies for Optimization

- Heuristic methods: Relies on rules of thumb and expert knowledge.
- Mathematical modeling: Provides more robust solutions.
- Machine learning approaches: Analyze complex datasets to uncover patterns and optimize control sequences dynamically.

INCORPORATING ENERGY REPORTING CAPABILITIES INTO CONTROLS AND MONITORING +

Demonstrative Examples

- HVAC System Optimization: Dynamically adjusts airflow based on occupancy levels detected through CO2 sensors.
- Industrial Process Control: Uses a predictive model that forecasts demand based on historical data.
- Smart Grid Applications: Uses advanced metering infrastructure and real-time data analytics to optimize energy distribution.

Conclusion

- Optimizing control sequences for energy conservation is a multifaceted approach that integrates system understanding, advanced methodologies, and real-time data analytics.
- The implementation of optimized control sequences can lead to significant energy savings, cost reductions, and enhanced system performance across various applications.



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