

Safety Moment

100% Cotton Clothing for Electrical Work

Flame Resistance: Cotton doesn't melt onto the skin like synthetics.

- **Reduced Static:** Minimizes the risk of arc flash ignition.
- **Durability:** Insulates better under heat exposure.

Low Voltage Risks

- Arc flashes and fires can happen, even at low voltage.
- Equipment failure or wiring issues can trigger dangerous incidents.

When You Can Wear Non-Cotton

- **Meetings or Non-Electrical Tasks:** Customer/GC meetings, office work.

When 100% Cotton is Required

- **Hands-On Electrical Work:** Direct tasks with energized systems.
- **Maintenance/Troubleshooting:** Where electrical hazards may arise.

Key Takeaways

- Plan ahead: bring a change of clothes if needed.
- Perform pre-work safety checks.
- Cotton clothing is a simple but essential safety measure—protect yourself and your team.
- Know your arc incident energy exposure.



Introduction & Learning Objectives

What you will learn – key takeaways:

- Overview of 70B, cycle of maintenance
- Value of maintaining an electrical maintenance program (EMP)
- How to assess the condition of your equipment
- Understand the step-by-step process to transition equipment from condition 3, to 2, and 1
- How to lengthen your frequency of maintenance cycle time
- Improve workplace safety & equipment reliability



Where do NFPA 70 (NEC), NFPA 70B and 70E fit?

Electrical Cycle of Safety, build safe 70, operate safe 70E, maintain safe 70B



While OSHA sets the regulatory framework, the NEC provides technical requirements for installations, NFPA 70E offers guidance for workplace safety practices, and NFPA 70B focuses on *equipment maintenance* to ensure reliability.

OSHA

OSHA included electrical safety requirements in standards both for general industry (29 CFR 1910 Subpart S) and construction (29 CFR 1926 Subpart K)

NFPA 70 (NEC) - Build Safe

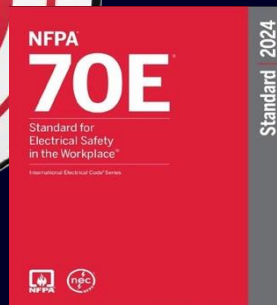
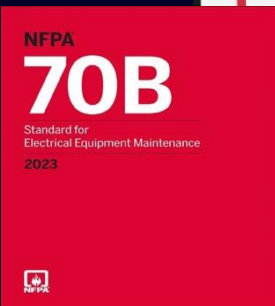
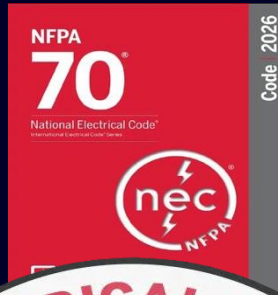
NEC (National Electric Code) is not law but is widely adopted by states and jurisdictions as part of building codes and is enforced by local authorities (AHJ).

NFPA 70E - Operate Safe

OSHA often references NFPA 70E as a recognized industry standard for electrical safety. Following 70E guideline is considered a best practice for meeting OSHA electrical safety requirements.

NFPA 70B - Maintain Safe

NFPA 70B complements OSHA regulations, NEC standards, and the references in 70E for properly maintained equipment by providing a standard set of maintenance practices and recommendations for frequency.

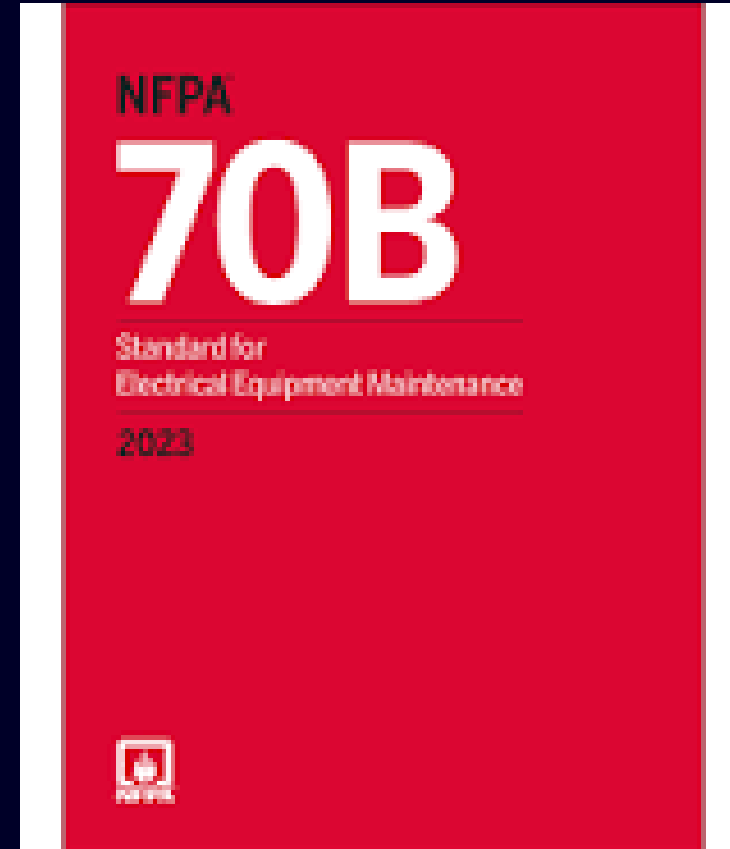


NFPA 70B 2023 Edition, Standard for Electrical Equipment Maintenance

NFPA 70B was First Released in 1967

- Addresses preventive maintenance for
 - Electrical
 - Electronic
 - Communication systems and equipment

NFPA 70B 2023 Edition became a standard that can now be both utilized as a guideline and/or enforced.



Evolving Joint Commission Expectations

Physical Environment Standards and Survey Readiness (2026)

Accreditation 360: New PE Chapter

Effective January 2026, EC (Healthcare NFPA 99) and Life Safety (NFPA101) chapters are consolidated into a unified Physical Environment (PE) chapter. EC.02.05.01 now maps to PE.02.05.xx.

Outcome-Based Compliance

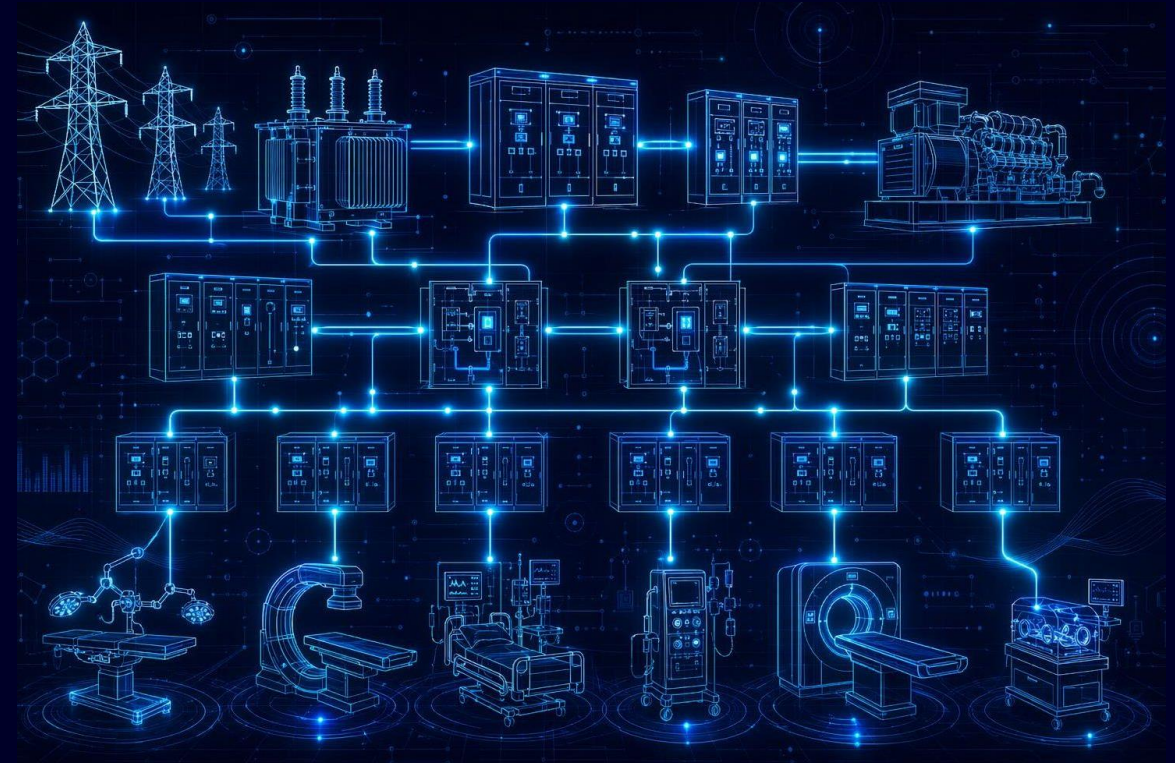
Surveyors now require timestamped, technician-signed evidence of continuous program execution against full referenced codes, not just policy documents.

Mandatory Maintenance Management Program

A documented MMP is now mandatory. Facilities must demonstrate compliance with entire NFPA codes, requiring deeper operational understanding and cross-functional collaboration.

Streamlined but Substantive

Elements of performance reduced by 48%, but core requirements remain intact. Surveys under the revised PE standards are already underway.



What This Means in Practice

The Shift to Risk- and Condition-Based Maintenance

From Time-Based to Condition-Based

Maintenance is shifting from fixed intervals to strategies based on equipment condition and risk assessment.

Advanced Diagnostic Technologies

Tools like infrared thermography and power quality monitoring detect issues before failures occur.

Role of Qualified Service Partners

Hospitals increasingly use external experts for specialized testing while retaining compliance responsibility.

Proactive Risk Management

The new approach focuses on managing risk and ensuring reliability to support uninterrupted patient care.

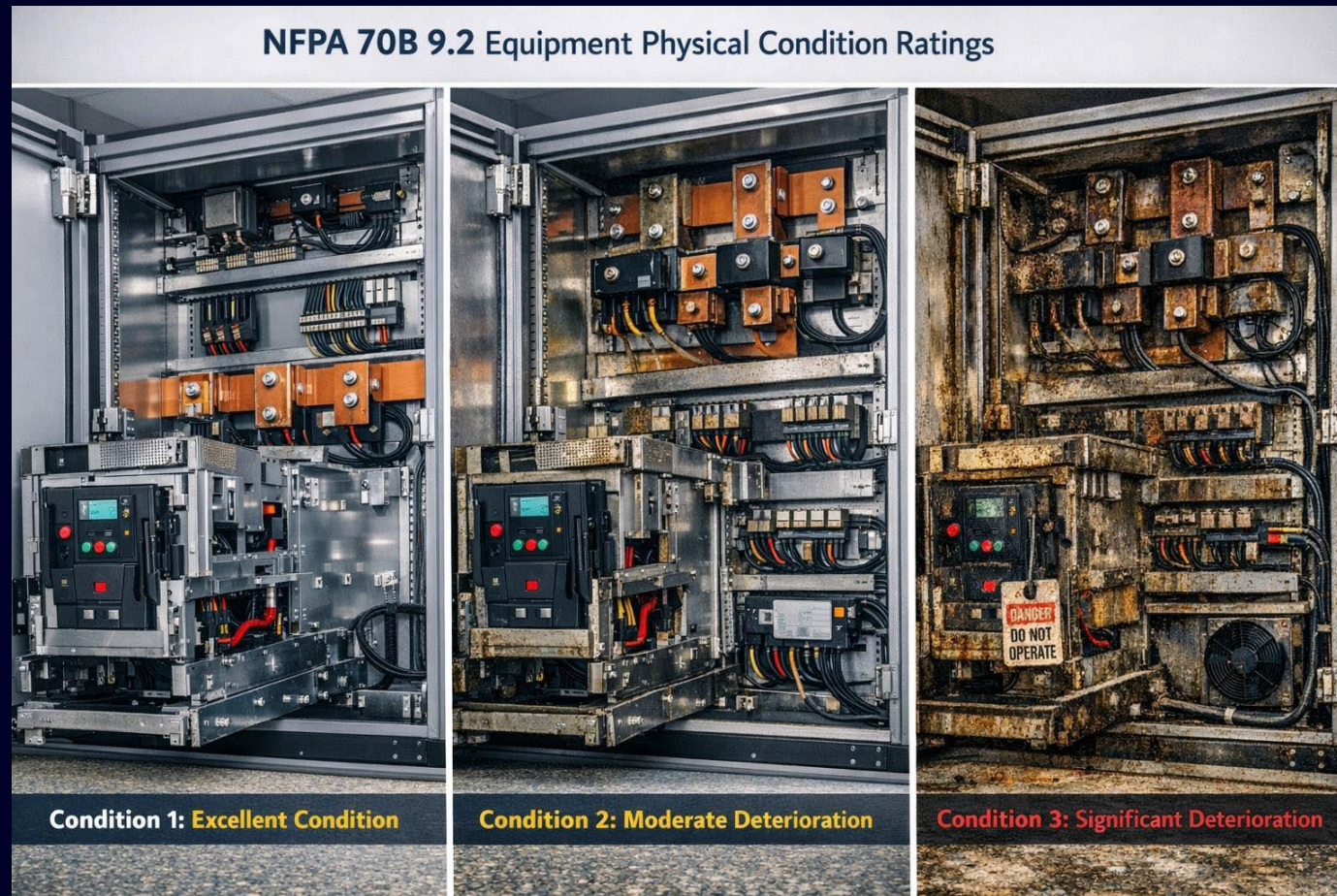


Agenda

1	Equipment Condition Assessments
2	Moving Equipment from Condition 3 to 2 to 1
3	Frequency of Maintenance
4	Modernization - Circuit Breaker, Relays, and Sensors
5	Condition Monitoring
6	Predictive Techniques
7	Conclusions & Next Steps
8	Q&A

9.2 Equipment Condition Assessment

9.2.1 Physical Condition. Equipment that is included in the EMP shall be assessed for current condition in accordance with 9.2.1.1 through 9.2.1.3.



Defined Condition of Maintenance Criteria and Service Intervals

NFPA 70B: 2023 9.3.1.1, 9.3.1.2, and 9.3.1.3

	Switchgear	Switchboards	Substations	Circuit Breakers	Busways
Condition 1 Criteria 1. Equipment appears like new 2. Clean and moisture free 3. Addressed notifications of continuous monitoring systems 4. No active predictive recommendations 5. Previous Maintenance performed in accordance with the EMP	60 Months	60 Months	60 Months	60 Months	60 Months
Condition 2 Criteria 1. Maintenance deviation and higher frequency from past results 2. Previous cycles revealed issues requiring repair or replacement of major components 3. Prior notifications from continuous monitoring system since prior assessment 4. Active recommendations from predictive techniques	36 Months	36 Months	36 Months	36 Months	36 Months
Condition 3 Criteria 1. Missed the last two successive maintenance cycles 2. Previous two maintenance cycles required repair or replacement of major components 3. Active and unaddressed notification from the continuous monitoring system 4. There are urgent actions identified from predictive techniques	12 Months	12 Months	12 Months	12 Months	12 Months

Restricted | © Siemens 2024 | Jason Aseniero | SI EP CRM-SYS DES | 2024-10-10

9.2 Equipment Condition Assessment - .1

9.2.1 Physical Condition. Equipment that is included in the EMP shall be assessed for current condition in accordance with 9.2.1.1 through 9.2.1.3.

9.2.1.1 Equipment Physical Condition 1 shall be assigned where all the following criteria apply:

- (1) The equipment is in like new condition.
- (2) The enclosure is clean, free from moisture intrusion, and tight.
- (3) There are no unaddressed notifications from the continuous monitoring system.
- (4) There are no active recommendations from maintenance activities or predictive techniques.
- (5) Previous maintenance has been performed in accordance with the EMP.

Assessment – Highest Condition Rating



Performance and appearance are consistent with new or recently commissioned equipment.



Enclosure integrity has been maintained: no moisture intrusion, debris, dust accumulation, or seal failures.



There are no ignored or deferred condition indicators.



Prior maintenance, IR, PD, testing, or inspections produced no open findings requiring action.



The asset has been maintained exactly as defined in the Electrical Maintenance Program (EMP).

Table 9.3.2 Time Based Maintenance Intervals

Product	Scope of Work	Equipment Condition Assessment		
		Condition 1	Condition 2	Condition 3
Molded-case/insulated-case/low-voltage power circuit breakers	Visual inspection, Cleaning	60 months	36 months	12 months
	Lubrication, Mechanical servicing	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months

9.2 Equipment Condition Assessment - .2

9.2.1 Physical Condition. Equipment that is included in the EMP shall be assessed for current condition in accordance with 9.2.1.1 through 9.2.1.3.

9.2.1.2 Equipment Physical Condition 2 shall be assigned where both the criteria from 9.2.1.1(1), 9.2.1.1(2), and 9.2.1.1(5) and the criteria from any of the following apply:

(1) Maintenance results deviate from past results or have indicated more frequent maintenance in accordance with manufacturer's published data.

(2) The previous maintenance cycle has revealed issues requiring the repair or replacement of major equipment components.

(3) There have been notifications from the continuous monitoring system since the prior assessment.

(4) There are active recommendations from maintenance activities or predictive techniques.



Assessment -- Acceptable condition with Emerging Issues. Has been **previously maintained per EMP.**



Manufacturer data or internal trend analysis indicates **shorter recommended maintenance intervals.**



The last maintenance cycle identified issues requiring **repair or replacement of major components**—even if corrective work was completed.



Alerts indicate **detectable early-stage degradation.**



NFPA 70B explicitly ties physical condition ratings to **action status**, not just observed defects.



9.2 Equipment Condition Assessment - .3

9.2.1 Physical Condition. Equipment that is included in the EMP shall be assessed for current condition in accordance with 9.2.1.1 through 9.2.1.3.

9.2.1.3 Equipment Physical Condition 3 shall be assigned where changes in operation are noted or where any of the following criteria applies:

(1) The equipment has missed the last two successive maintenance cycles in accordance with the EMP.

(2) The previous two maintenance cycles have revealed issues requiring the repair or replacement of major equipment components.

(3) There is an active or unaddressed notification from the continuous monitoring system.

(4) There are urgent actions identified from maintenance activities or predictive techniques.



Assessment - Degraded condition with elevated risk – near-term corrective action required.



Condition 3 may be assigned even if no visible damage exists—because the equipment's condition is no longer verifiable.



Continued operation without intervention increases the likelihood of forced outages.



Condition 3 is not about alarms existing—it's about alarms **remaining open**. Active alerts place the asset firmly in the late-P zone.



NFPA 70B distinguishes between:

- Planned corrective actions (Condition 2)
- Urgent actions (Condition 3)



Agenda

Equipment Condition Assessments

2 Moving Equipment from Condition 3 to 2 to 1

3 Frequency of Maintenance

4 Modernization - Circuit Breaker, Relays, and Sensors

5 Condition Monitoring

6 Predictive Techniques

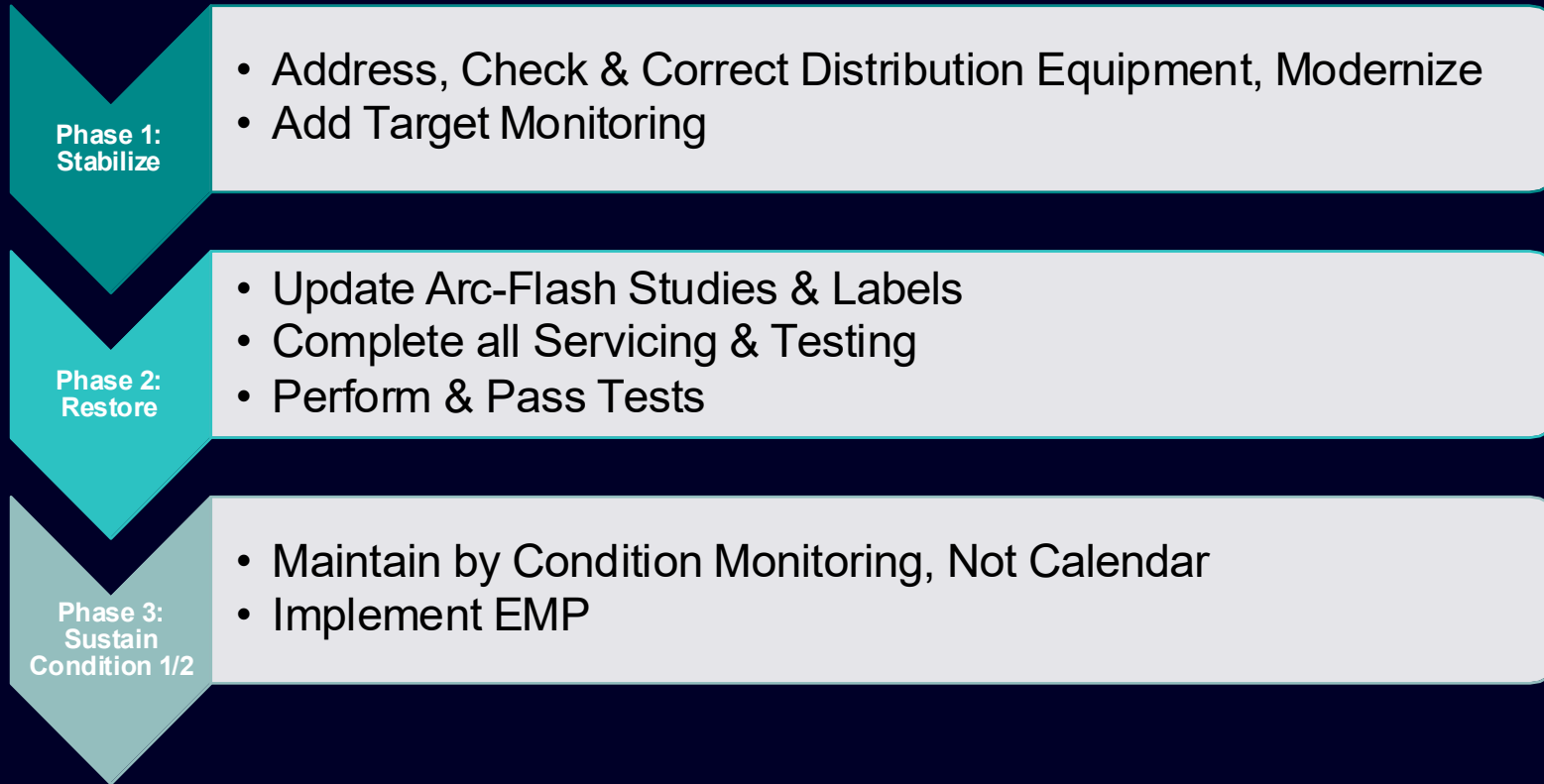
7 Conclusions & Next Steps

8 Q&A

Condition 3 → Condition 1 Transition Roadmap

Goals = Extend Time Between Maintenance, Improve Safety & Reliability

NFPA 70B Chapter 9, now explicitly recognizes that **continuous monitoring notifications** and **predictive technique recommendations** are part of how you set maintenance intervals



Agenda

Equipment Condition Assessments

Moving Equipment from Condition 3 to 2 to 1

3 Frequency of Maintenance

4 Modernization - Circuit Breaker, Relays, and Sensors

5 Condition Monitoring

6 Predictive Techniques

7 Conclusions & Next Steps

8 Q&A

Frequency of Maintenance NFPA 70B, 2023

NFPA 70B: Standard for Electrical Equipment Maintenance (2023)

A.9.1.1.1

- Maintenance intervals are used to plan inspections, testing, monitoring, analysis and service of equipment on a predetermined frequency. The interval frequency is commonly calendar-based but other possibilities, such as a frequency based on the number of switch operations, cycle count, or hours of operation can be used.
- The intervals can be modified based on the type, criticality, and perceived condition of the equipment.

9.1.2 Maintenance Frequency Modifications

9.1.2.1

- Once the initial frequency for inspection and tests has been established based on the intervals listed in Table 9.2.2 and the equipment condition assessment, this frequency shall be adhered to for at least two maintenance cycles unless unexpected failures occur.



Frequency of Maintenance, 70B 2023 to 2026

The objective of an equipment maintenance program is to **maintain safe operation and production while reducing or eliminating system interruptions and equipment breakdowns.**



Maintenance Intervals

- Design, construction, & commission data required
- Maintenance checklist is defined based on equipment type
- Frequency is calendar-base and influenced by criticality and perceived condition

Continuous Monitoring

- Based on actual conditions through real time monitoring, operational cycle count, etc.
- Monitoring enables real time alarming



- Maintenance intervals

Predictive Techniques

- Monitor more than one input (current, temperature, humidity, etc.)
- Based on dynamic behavior rules for components or equipment
- Software or advisors analyze and interpret data and provide recommended maintenance actions before alarm set points are reached



- Maintenance intervals
- Continuous monitoring

Agenda

 **Equipment Condition Assessments**

 **Moving Equipment from Condition 3 to 2 to 1**

 **Frequency of Maintenance**

4 **Modernization - Circuit Breaker, Relays, and Sensors**

5 **Condition Monitoring**

6 **Predictive Techniques**

7 **Conclusions & Next Steps**

8 **Q&A**

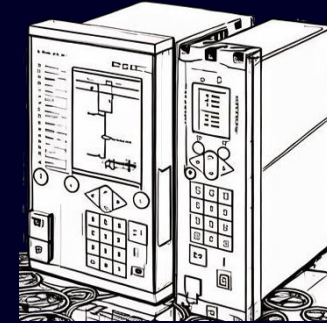
Modernization

A process to prescribe, implement, and document corrective measures based on collected data



Circuit Breaker Retrofits

- **Improved protective functions** -- Enhanced trip curves and zone-selective interlocking
- **Reduced arc flash risk** -- Faster clearing times, lower incident energy
- **Remote switching** -- Reduces need to access energized equipment
- **Better diagnostics / Connectivity** -- Real-time status, event logs, and SCADA integration
- **Improved trip accuracy** -- Reduced nuisance trips and improved coordination
- **Lower cost / Less downtime** -- Versus full replacement; in-place retrofit minimizes outage
- **Spare parts availability** -- Current-generation parts extend serviceable life



Protective Relay Upgrades -- Digital Protection

- **Improved fault detection** & system coordination
- Arc flash detection
- Enhanced safety
- **Better diagnostics**
- Communications / Connectivity
- Continuous Monitoring
- **Spare parts availability** -- Current-generation parts extend serviceable life

Modernization

A process to prescribe, implement, and document corrective measures based on collected data



Meter Upgrades—Digital Protection

- **Identify Inefficiencies** – Able to get insights to your subsystems
- **Save Money** – Once you have identified inefficiencies in power consumption, take necessary steps to design and implement energy-savings programs to save money
- **Increase Profit Margin** – With reliable energy management system, you spend less money and make more profit
- **Decrease Downtime** – Power monitoring systems and digital services can send alerts to help cut back downtime, increase reliability, and efficiency

Sensor Upgrades—Digital Protection

- **Temperature & Thermal** – Used to detect overheating due to loose connections, overloading, and insulation breakdown
- **Partial Discharge** – Used to detect insulation degradation before catastrophic failure
- **Environmental** – Monitor environmental conditions such as dust, water leakage, corrosion, humidity, and smoke for prevention due to environmental conditions
- **Other** – Vibration and mechanical sensors for rotating equipment, insulation and dielectric sensors to monitor insulation, and arc flash sensors for fast fault detection and energy isolation

Agenda

 **Equipment Condition Assessments**

 **Moving Equipment from Condition 3 to 2 to 1**

 **Frequency of Maintenance**

 **Modernization - Circuit Breaker, Relays, and Sensors**

5 **Condition Monitoring**

6 **Predictive Techniques**

7 **Conclusions & Next Steps**

8 **Q&A**

Condition Monitoring

A.9.1.1.2 Continuous monitoring of specific equipment conditions can be performed using an uninterrupted method of data collection.

Definition:

A proactive maintenance strategy assessing real-time health of electrical assets using diagnostic technologies



Benefits:

Enhances Reliability

- Detects developing electrical issues early (e.g., overheating, insulation degradation), preventing unexpected failures and outages.

Reduces Maintenance Costs

- Shifts maintenance from time-based to condition-based, avoiding unnecessary work and focusing resources where risk is highest.

Extends Equipment Life

- Corrects abnormal conditions (heat, vibration, partial discharge) before they accelerate wear and aging of assets.

Improves Safety

- Early fault detection reduces arc flash, fire risk, and the need for intrusive work on energized equipment.

Condition Monitoring

A.9.1.1.2 Continuous monitoring of specific equipment conditions can be performed using an uninterrupted method of data collection.



Why This Matters for NFPA 70B

NFPA 70B emphasizes condition-based maintenance and risk-informed decision-making. Condition monitoring directly supports these principles by:

- Providing measurable data to justify maintenance intervals
- Supporting documented risk evaluations
- Demonstrating proactive safety and reliability management

Section 9.2.1

- There are no unaddressed notifications from the continuous monitoring system

Section 9.2.1.2

- There have been notifications from the continuous monitoring system since the prior assessment

Section 9.2.1.3

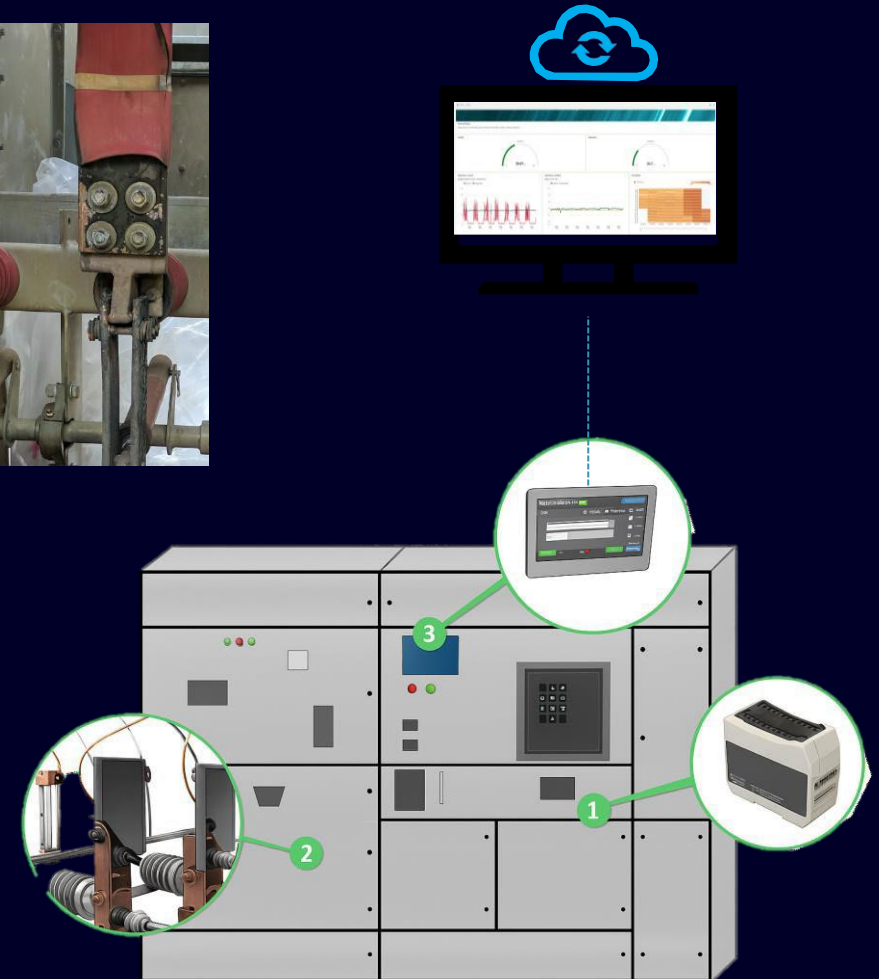
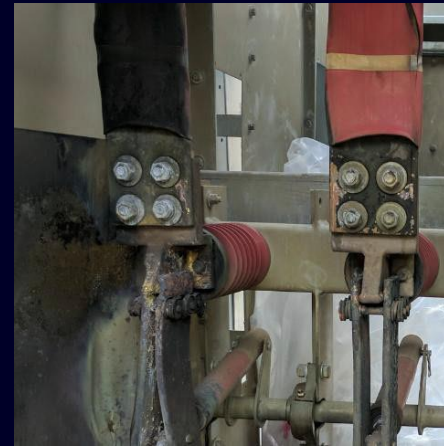
- There is an active or unaddressed notification from the continuous monitoring system

Condition Monitoring

A.9.1.1.2 Multiple types of data can be continuously monitored, including voltage, current, temperature, humidity, cycle count, open/closed state, and others.

Examples

- Thermal Monitoring detects overheating terminations in switchgear months before they fail, preventing unexpected shutdowns.
- Correcting abnormal heating in transformers prevents accelerated insulation aging.
- Detecting bearing degradation in large motors through vibration monitoring avoids rotor damage and rewinds.
- Maintenance resources are focused on high-risk assets identified by monitoring data, instead of spreading effort equally across all equipment.
- Nonintrusive monitoring techniques reduce the need to open energized equipment, minimizing worker exposure.



Agenda

 **Equipment Condition Assessments**

 **Moving Equipment from Condition 3 to 2 to 1**

 **Frequency of Maintenance**

 **Modernization - Circuit Breaker, Relays, and Sensors**

 **Condition Monitoring**

6 **Predictive Techniques**

7 **Conclusions & Next Steps**

8 **Q&A**

Predictive Analytics

A. 9.1.1.2 Predictive techniques monitor multiple conditions in equipment using various sensors and analyze and interpret the data using analytical methods and algorithms.

Predictive analytics uses historical data, real-time condition monitoring, and analytical models to forecast equipment degradation and failure before it occurs, enabling maintenance actions to be planned in advance rather than performed reactively.

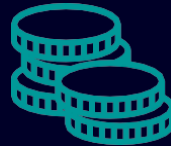
Benefits



Improves reliability by anticipating failures before they impact operations



Enhances safety by reducing exposure to unexpected faults, arc flash, & fire events



Lowers maintenance costs by optimizing timing & scope



Enables data-driven decision-making & prioritized maintenance planning



Extends asset life through early intervention & stress reduction

Predictive Analytics

A. 9.1.1.2 Predictive techniques monitor multiple conditions in equipment using various sensors and analyze and interpret the data using analytical methods and algorithms.

Why This Matters for NFPA 70B

Predictive analytics operationalizes NFPA 70B—shifting maintenance from reactive to proactive through data-driven, risk-based decisions.

Section 9.2.1

- There are no active recommendations from maintenance activities or predictive techniques.

Section 9.2.1.2

- There are active recommendations from maintenance activities or predictive techniques.

Section 9.2.1.3

- There are urgent recommendations from maintenance activities or predictive techniques.



Predictive Analytics

A. 9.1.1.2 Proactive techniques identify trends or issues and notify personnel of recommended actions before the condition reaches an alarm point or alert them to urgent issues that are at or over a predetermined level.

Examples

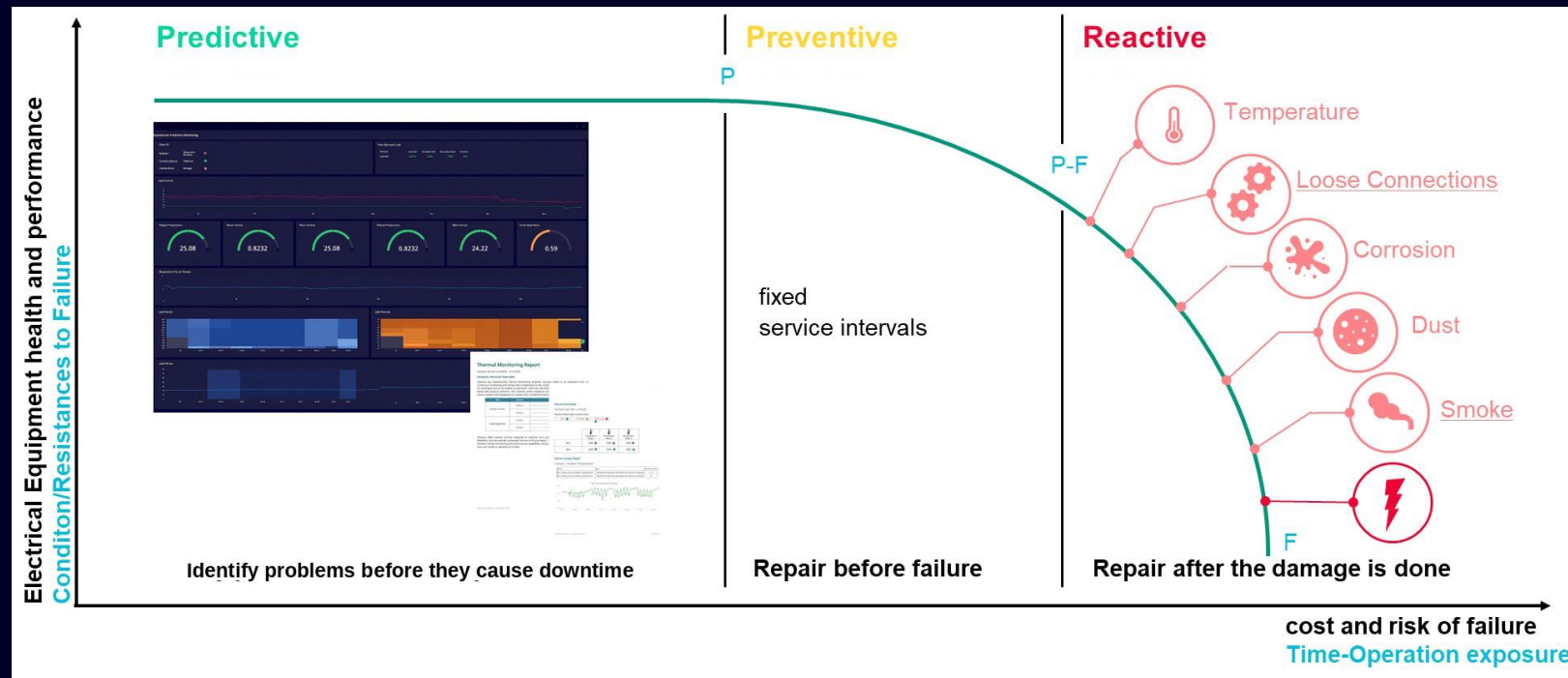
- Identifies failure trends early, preventing unexpected outages (Rising thermal stress and load imbalance trends or partial discharge)
- Maintenance is performed only when needed, based on asset condition and risk (stable circuit breakers avoiding unnecessary time-based overhauls, prioritization of high-risk assets)
- Early corrective actions reduce cumulative thermal, electrical, and mechanical stress (Load trend forecasting or abnormal heating)
- Reduces exposure to arc flash events, fires, and emergency work (detection of overheating connections)



Condition Monitoring & Predictive Analytics

9.1.1.3 A P–F curve is a graph that shows the health of equipment over time to identify the interval between potential failure and functional failure.

Monitoring your electrical equipment condition enables scheduling **the ideal time for maintenance, reducing costs and increasing availability**



Agenda

 **Equipment Condition Assessments**

 **Moving Equipment from Condition 3 to 2 to 1**

 **Frequency of Maintenance**

 **Modernization - Circuit Breaker, Relays, and Sensors**

 **Condition Monitoring**

 **Predictive Techniques**

 **7** **Conclusions & Next Steps**

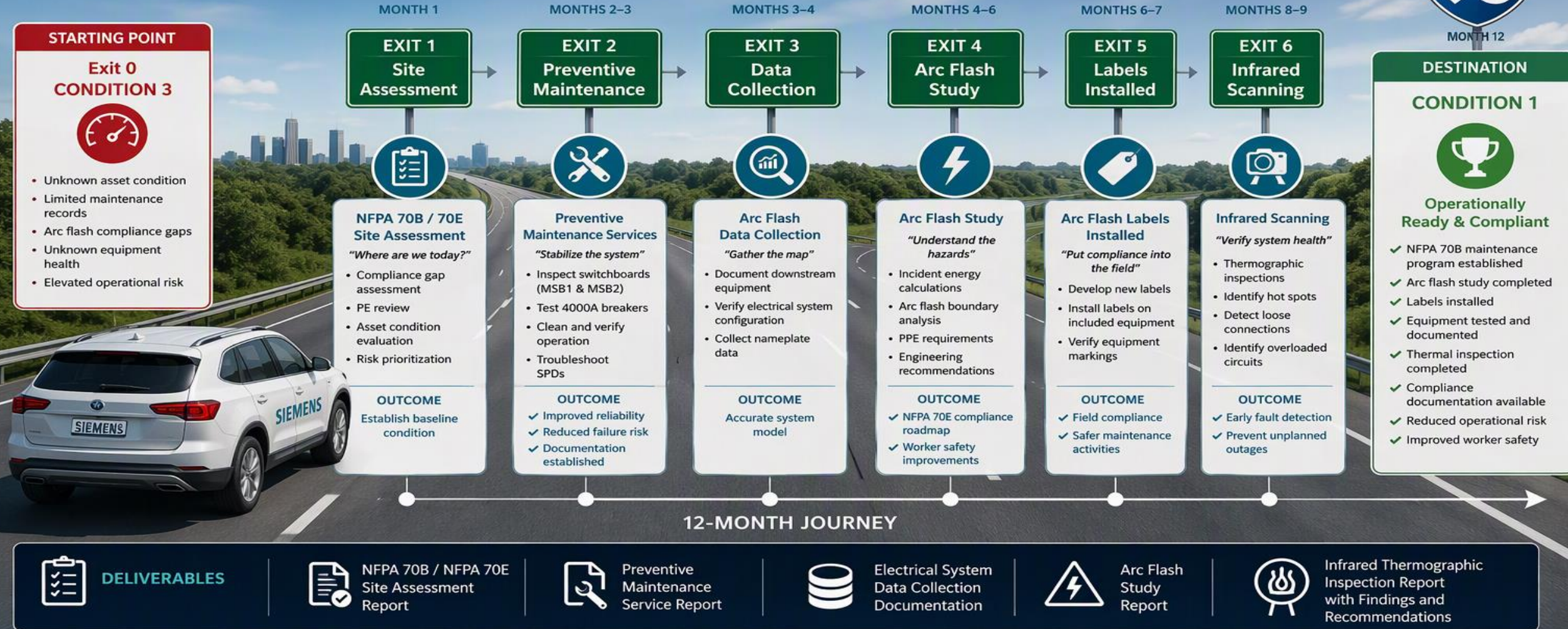
 **8** **Q&A**

Roadmap to NFPA 70B / 70E Compliance

Your 12-Month Journey from Condition 3 to Condition 1

Siemens is your partner and driver on the road to electrical safety, reliability, and compliance. This proven roadmap provides a clear path from today's risks to tomorrow's confidence.

SIEMENS
Ingenuity for Life



One integrated journey. Every step builds on the last. Together, we move from risk to reliability, from uncertainty to compliance.

Conclusion & Next Steps

Key Takeaways

- NFPA 70B gives you a **defensible, auditable path** to safer operations
- Condition assessments (1–3) **influence risk and reliability**
- Condition 3 = **highest risk**, this presentation shows ways to address it now
- Monitoring & analytics **turn failures into scheduled maintenance**
- Modernization **enables condition-based compliance**

What You Should Do Differently

- Assess and **document equipment condition** as part of your EMP
- **Act quickly on alerts** to prevent degraded conditions
- Shift from calendar-based to **condition-based maintenance**
- **Use analytics** to extend maintenance intervals
- Treat reliability as a **safety strategy**

The Outcome

Reduced risk | **Improved** safety, reliability, & resiliency | **Extended** asset life | NFPA 70B **compliance**

References

- NIST SP 800-82r3, Guide to Operational Technology (OT) Security
- IEEE 3006 Historical Reliability Data, IEEE 3006.2-9 Reliability
- IEEE 1584 Arc Flash
- IEEE 3000 Standards Collection (replaces Color Books); use IEEE 3004.1-2018, IEEE 3002.3-2018, IEEE3002.7-2018
NFPA 70, 70B, 70E