ti Current Trends

Volume.4 No.3 October 25th, 2024

Comprehensive Guide on Effective Preventive Maintenance

In this edition, we delve into the technicalities of how to carry out Preventive Maintenance (PM) effectively in Electrical Systems. As previously discussed, authorized service centres play a crucial role in ensuring maintenance is done according to manufacturer standards. Now, we turn our focus to the practical steps and best practices that will ensure PM is executed efficiently to maintain long-term operational efficiency and prevent downtime leading to huge cost implication.

How Should Preventive Maintenance Be Done?

The process of preventive maintenance involves regular monitoring and servicing of equipment before breakdowns occur. This proactive approach minimizes unscheduled downtime, extends the life of the equipment, and ensures operational safety. To guide this process, we introduce the **Panchasutra** —five fundamental principles that are essential for maintaining electrical systems.

The Five Key Principles of Panchasutra:

1. **Clean (Thumb):** Proper cleaning is the foundation of preventive maintenance. Electrical systems are especially sensitive to dust, debris, and corrosion, which can impair performance or lead to hazardous situations.

a. **Dust and Debris Removal:** Over time, dirt can accumulate inside electrical switchgears in the switchboards, transformers, and control systems, potentially leading to overheating or electrical shorts. Use a vacuum or dry compressed air to clean the inside components. In recent development compressed liquid cleaning are available however, is yet to be experienced, as they can cause damage if they get inside the equipment.

b. Cable and Terminal Cleaning: Cables and electrical terminals can gather dust and corrosion, leading to poor connections, electrical resistance, or even arcing. Non-conductive cleaning agents designed specifically for electrical systems should be applied to remove grime, ensuring proper conductivity and reducing the risk of failure.

2. Lubricate (Index Finger): Lubrication is crucial in maintaining the operational smoothness of moving parts, particularly in systems with mechanical relays, circuit breakers, and motorized components.

a. Lubricating Moving Parts: Mechanical components in electrical systems—such as contactors, circuit breaker mechanisms, or switchgear—need periodic lubrication to minimize wear from friction. Ensure that the recommended lubricant as specified by the manufacturer are used to prevent metal-to-metal contact, reduce wear, and ensure smooth operation.

b. Calibration and Adjustment: Electrical systems often rely on precise settings, such as in overcurrent protection devices. Over time, these settings may drift due to environmental factors or change in load patterns. Regular calibration and adjustment of such devices ensure optimal protection and system functionality.

3. Tighten (Middle Finger): Regular inspection and tightening of screws, nuts, and bolts are critical, especially in AC Electrical Systems, where vibrations and thermal cycling—caused by fluctuating load patterns—can gradually loosen fasteners. These shifts can compromise both the mechanical integrity and electrical connections, potentially leading to overheating, increased resistance, or even system failure. Proactively addressing this issue ensures safe, reliable operation, maintaining optimal performance and preventing costly breakdowns.

4. Inspect (Ring Finger): Regular inspections allow Engineers / Technicians to detect and correct potential issues before they become serious. A visual check, followed by targeted testing, forms the backbone of any preventive maintenance routine.

Visual Inspection:

Labels and Identification: Ensure all switchboards / switchgears and wires are clearly labelled for easy identification during repairs or upgrades.

Physical Condition:

- **Surface Integrity:** Check for signs of wear, including rust, cracks, or corrosion on enclosures, mounts, and external parts.
- **Connections:** Verify that all electrical connections are intact, secure, and free of corrosion. Loose connections can lead to overheating and energy loss.

Mechanical and Environmental Inspections:

- Ensure that enclosure seals are intact to prevent moisture ingress, particularly in outdoor installations.
- Confirm that ventilation systems, such as cooling fans, are operating correctly.

5. **Test (Little Finger):** After cleaning, lubricating, tightening, and inspecting, testing is essential to verify that the equipment is functioning as expected. Testing detects issues that may not be visible through a simple visual inspection.

Electrical Testing:

- Insulation Resistance Testing: This test helps determine if the insulation on wires and electrical components is still effective at preventing shorts or leaks. A degradation in insulation can lead to equipment failure.

- Continuity Testing: Ensures that all circuits are complete and capable of carrying current without interruption.

- Contact Resistance Testing: High resistance in contact points, especially in switches and circuit breakers, can lead to overheating. Testing ensures all contact points are functioning properly.

Release Testing: Release testing is crucial for ensuring the proper functionality and safety of electrical systems. It can be conducted using the following methods:

i. **Secondary Testing Kit Provided by the Manufacturer:** Using a secondary testing kit supplied by the manufacturer offers several advantages, primarily in terms of efficiency. This method significantly reduces the time required for release testing, allowing for quicker evaluations of system readiness and safety. The convenience of a manufacturer-provided kit often means that it is tailored to the specific equipment, ensuring compatibility and streamlined testing procedures.

Lacuna: However, a notable limitation of most secondary testing kits is that they do not test the Primary and Secondary Current Transformers (CTs) located within the primary card of the release system. As a result, while the secondary testing may provide valuable insights, it does not constitute a comprehensive testing solution. This gap means that potential issues with the CTs might go undetected, leading to incomplete assessments of the system's integrity and reliability.

ii. **Primary Testing Kit:** In contrast, employing a primary testing kit, although it requires more time and effort, is essential for thorough release testing. This method should be performed at least annually to ensure comprehensive evaluation and verification of all system components, including the CTs. The primary testing kit allows for a detailed examination of the entire release mechanism, providing a more robust assurance of functionality and safety.

6. In conclusion conducting primary testing is vital, as it helps identify and rectify any underlying issues that could compromise the system's performance. Despite the additional resources required, this method is critical for maintaining operational reliability and compliance with safety standards.

Note: All release testing equipment should be calibrated.

7. **Documentation and Record Keeping:** Effective preventive maintenance isn't complete without proper documentation, which is vital for both tracking and compliance.

- **Maintenance Logs:** Keeping detailed logs of all maintenance activities—what was inspected, tests performed, adjustments made, and parts replaced—allows you to track the health of the equipment over time. It also helps identify recurring issues, providing valuable insight for future maintenance or equipment replacement decisions.

- **Compliance Documentation:** Many regulatory bodies require proof that equipment is being properly maintained, especially in industries where safety is a top priority. Detailed records of your maintenance activities ensure you meet regulatory standards and can provide evidence during audits or inspections.

Conclusion

The Panchasutra method, encapsulated by the five fingers, offers a structured approach to preventive maintenance. By regularly cleaning, lubricating, tightening, inspecting, and testing electrical equipment, engineers can reduce unscheduled downtime, extend equipment lifespan, and maintain a safe working environment.

Preventive maintenance is not just a procedure; it is a proactive culture that avoids costly breakdowns and keeps systems running smoothly. A well-structured preventive maintenance schedule ensures operational efficiency, reduces long-term costs, and minimizes the risk of unexpected failures. By preventing problems before they arise, you can keep your systems optimized, safe, and reliable.