World Class Maintenance — Best Practices in Electrical Maintenance

As maintenance departments have become major cost centers within industrial plant organizations, more management attention is being applied to reducing maintenance costs while maintaining operability and reliability. Through the application of best practices and with the use of sound technical expertise, a world class maintenance program can be achieved which can result in significant reductions in maintenance costs and savings associated with unplanned outages and equipment failures. To achieve these cost benefits some basic concepts should be considered:

- Corporate Philosophy
- Asset Management
- Maintenance Planning
- Preventive Maintenance
- Predictive Maintenance
- Proactive Maintenance
- Performance Measurement and Tracking
- Continuous Improvement

This article will touch on each concept as it applies to achieving world class electrical maintenance in an industrial environment.

Corporate Philosophy

To apply best practices in electrical maintenance, the maintenance and production organizations must typically have a philosophical shift in organization and their use of technology. This requires a commitment to changing the way maintenance is typically performed. Unfortunately, most people are resistant to change; therefore, a first priority is to educate affected personnel on the realization that change is necessary. If the maintenance and production organizations make the decision to become world class, a disciplined and committed plan for re-engineering the electrical maintenance function must be developed. Plant operation and support personnel should participate in the re-engineering process so that ownership is inherent in the process. Personnel who understand and agree with a process are more willing to cooperate and less likely to create difficulties later on. Teamwork throughout the organization realignment process is critical to achieve success. This plan must be reviewed and agreed upon by top management and then implemented as rapidly as possible.

Asset Management

For world class electrical maintenance, the plant electrical infrastructure and other critical systems and equipment should be organized into asset centers and treated as individual cost centers with all costs, equipment, personnel, and material tracked and monitored to allow for accurate cost identification and control.
The nature of maintenance personnel is to hoard critical individual parts and supplies, effectively making any warehouse/inventory control system ineffective. It is essential that required maintenance parts be on hand and adequate to meet the needs of all work in progress and emergencies. A process for maintaining and controlling spare parts inventories is essential to a cost effective maintenance program. Therefore, purchasing also plays an important role in the modern, integrated maintenance organization. The use of an automated system to trigger purchase orders that are designed to facilitate stocking levels as they are established is essential. Adequate planning and proper establishment of workable stock levels (controlled by supply lead-time and usage) can prevent stock outages and overstocking.

Maintenance Planning

With assets and parts identified, corrective and preventive maintenance can be carried out in a more meaningful fashion. Personnel can be assigned to meet the needs of the newly created asset centers and their costs directly associated with the individual asset center. A work order system should be established which communicates what is being done, by whom, where, when, and why. Written procedures for the work order process should be developed and strictly adhered to. Detailed responsibilities are assigned to specific personnel for the completion and reporting of work. Planning is the critical stage in the work order system so that expected labor, material, and time line requirements for maintenance are accurately estimated and scheduled to meet both maintenance and production needs. Additionally, the planning process should ensure that cost and scope of work are adequately tracked. For electrical maintenance, NFPA 70B-2006, Recommended Practice for Electrical Equipment Maintenance, and NETA’s MTS-2005 are extremely useful references in performing the electrical maintenance planning function. Specifically, use of MTS-2005 Appendix B, Frequency of Maintenance Tests, is invaluable in planning electrical maintenance activities.

Preventive Maintenance (PM)

The objective of the PM program is to reduce downtime and maintain safety to a level that is acceptable and manageable. Implicit in this description is that an effective PM program is sufficient but not excessive. It requires that an evaluation of equipment and systems be performed so that equipment which is critical to reliable production and/or employee safety receives the bulk of the attention. Obvious in this statement is that the people performing this evaluation are knowledgeable of the equipment and qualified and experienced in recognizing potential problems. Additionally, it is essential that there be coordination and cooperation between operations and maintenance managers.

Predictive Maintenance (PdM)

Any effective PM program includes some components of predictive maintenance. PdM activities are typically non-invasive and are performed while equipment is operating. Through proper application of the many and varied predictive maintenance tools available to maintenance personnel, potential failure modes can be identified and used to effectively predict eventual failure with some degree of accuracy over time. This predictive capability allows for more effective maintenance planning and improved equipment availability. The more common predictive tools available for electrical maintenance include insulating oil sample analysis, infrared thermographic surveys, ultrasonic surveys, partial discharge testing, and walk-through inspections.

Proactive Maintenance (PAM)

Proactive maintenance is a term used to identify the enhancement of both the preventive and predictive maintenance technologies through the use of operating and maintenance history. Asset centers are evaluated for uptime versus downtime with written failure analyses provided for
unscheduled downtime. These failure analyses are then used for refining the preventive and predictive processes, activities, and schedules. Methodologies for determining and then modifying recommended maintenance frequencies based on operating and maintenance history are discussed in both NFPA 70B and MTS-2005. Proactive maintenance should provide managers with a vehicle to effectively reduce total maintenance costs while maximizing equipment production reliability and useful life.

Performance Measurement and Tracking

Accountability is required and must be built into the system. Activities need to be evaluated through key indicators of reliability and equipment condition and tracked over time for improvement measurement. The indicators are then used to highlight the success of the plan and serve to reinforce any actions taken. To reinforce the benefits of the overall electrical maintenance program, consideration should be given to documenting and reporting the success of the program by photographing examples of suspect equipment condition. This photographic evidence of electrical issues can then be reported to management to demonstrate the effectiveness of the program and provide a basis for training personnel in visible recognition for future inspections. Also to ensure that indicators are intelligently and expeditiously acted upon, a process that tracks and reports progress against the objectives should be implemented. A complementary review team of maintenance, operations, engineering, and supervisory personnel should be used to review and evaluate the results of electrical equipment performance and integrity testing as well as the impact on manufacturing reliability indicators.

Continuous Improvement

A corporate culture supporting continuous improvement activities is essential to achieve world class maintenance status. This concept of continuous improvement in electrical maintenance activities integrates preventive, predictive, and proactive maintenance with accountability for each asset center. In the industrial sector, there are many continuous improvement initiatives (i.e., reliability centered maintenance (RCM), total productive maintenance (TPM), reliability based maintenance (RBM), or other three-letter maintenance programs). The key to any of these initiatives being successful is the unified focus of the various plant organizations in meeting program objectives of improved performance, productivity, and reliability. This means that the facility has committed to superior work planning and execution, performance measurement and tracking, maintenance cost control, and failure analysis with corrective action.

To achieve a world class electrical maintenance program requires a corporate commitment which is communicated to and accepted by a qualified workforce. The electrical maintenance practices should include significant planning and scheduling emphasis. The requirements for spare parts inventory and the type of maintenance activities to be performed should be minimized yet sufficient to meet the objectives of the program. Maintenance best practices should include components of asset management, preventive maintenance, predictive maintenance, and proactive maintenance. Finally, the program should include attributes of continuous improvement and a process for performance measurement and tracking.

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