



Electrical Maintenance

And Its Relationship to Safety

What is Electrical Maintenance?

- It revolves around **maintaining and repairing** electronic equipment used in large facilities
- Facets of the work include **testing, fixing and replacing** equipment in buildings owned by corporations, government entities and modern industrial plants.
- One essential ingredient is knowledge of the **National Electric Code**, in addition to familiarity with local codes.



OSHA (Occupational Safety and Health Administration) and NFPA (National Fire Protection Association) states that equipment deterioration is normal, but equipment failure is not inevitable

- An effective electrical preventive maintenance program can reduce accidents, save lives, and minimize costly breakdowns and unplanned shutdowns of production equipment.

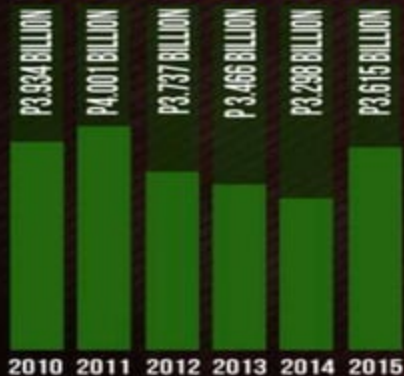


Why do we need electrical maintenance?

FIRE INCIDENTS NATIONWIDE

2010	10,773
2011	8,824
2012	8,798
2013	12,301
2014	15,897
2015	17,138

FIRE DAMAGE NATIONWIDE



- Many lives and properties are lost due to fires and electrocution.
- Just because electrical appliances and equipment appears to be functioning does not guarantee that there are no problems. It is often only during electrical maintenance work that hidden problems become apparent.
- Most of these fires and incidents of electrocution are attributed to "faulty electrical wiring" and "lack of maintenance."
- Economic losses brought about by fires contribute to reduced productivity and therefore affect the economy of the country.

Benefits of Electrical Maintenance

- Electrical Maintenance Can **Save Lives**
- Electrical Maintenance **Protects Expensive Equipment**
- Electrical Maintenance **Reduce Energy Costs**

"It can save lives, businesses/property because it may prevent electrical problems deteriorating to such an extent that they cause damage."



Safety-Related case for Electrical Maintenance.

- Dust, dirt, and other contaminants collect on equipment
- Vibration and Subsequent operations



- Heat and age
- Increased loads, motor starting surges, and power quality



The background is a dark blue gradient with faint, white, technical-style graphics. On the left side, there is a large circular scale with markings from 0 to 360 degrees. Several concentric circles and dashed lines with arrows are scattered across the image, giving it a technical or scientific feel.

ELECTRICAL HAZARDS

INDUSTRY | RESIDENTIAL | SCHOOLS

Relationship of Improperly maintained electrical equipment to the hazards of electricity

Improperly maintained equipment may expose workers to any electrical hazards:

- Improperly maintained tools or flexible cord sets (Extension Cord).
- Improperly maintained protective devices (Circuit breakers or fuses).
- Improperly maintained connections.
- Improperly maintained switchgear, motor control centers or panel boards.

Figures



Electrical Hazards

A dangerous condition where an individual could make an electrical contact with an energized equipment or a conductor which the person may sustain injury from it.



Industry | Residential | Schools

Organized and safe



Electrical Hazard: Examples



Industry

- Poorly installed and/or maintained electrical equipment
- Faulty Wiring
- Overloaded, overheated, or shortened outlets
- The use of flexible leads and extension cables (prone to damage)
- Using Equipment that is believed to be dead but is alive
- Incorrect use of replacement fuses
- Using Electrical Equipment near a source of water or with wet hands



Residential

- Frayed or worn electric cords
- Appliance plugs "Piggy Backed" on a single switch
- Electrical Appliances are used near water
- Extension cords being used instead of permanent indoor/ outdoor wiring
- Wet floors are present where electricity is used
- Electrical appliances that blow fuses, overheat, or spark heavily



Schools

- Overloaded circuits
- Power strips
- Extension Cords Electrical Panels
- Combustible decorations
- Worn or damaged cords
- Exposed Electrical wirings

Common Electrical hazards

ELECTRICAL HAZARDS	INDUSTRY	RESIDENTIAL	SCHOOLS
IMPROPER GROUNDING		✓	
EXPOSED ELECTRICAL PARTS	✓	✓	✓
INADEQUATE WIRING		✓	✓
OVERHEAD POWER LINES	✓		
DAMAGED INSULATION		✓	✓
OVERLOADED CIRCUITS		✓	✓
WET CONDITIONS		✓	
DAMAGED TOOLS AND EQUIPMENTS		✓	

Reference:

- <http://www.highspeedtraining.co.uk/hub/electrical-hazards-workplace/>
- <http://www.ncemcs.com/electricity/safety/hazards.htm>
- http://www.chico.ca.us/fire/documents/hazards_int he classroom.pdf
- https://www.osha.gov/dte/grant_materials/fy08/sh-17792-08/electrical_english_r6.pdf

Electrical Preventive Maintenance

What are proper electrical maintenance?

What is Electrical Preventive Maintenance (EPM)?

It is a process of:

- ▶ Inspecting
- ▶ Testing
- ▶ Analyzing
- ▶ Servicing
- ▶ **Mitigating Risks Associated with Electrical Systems and Equipment:** With The Purpose of Maintaining Safe Operations and Production By Reducing or Eliminating System Interruptions or Equipment Breakdown



What is Electrical Preventive Maintenance (EPM)?

- ▶ Electrical Systems Begin To Deteriorate Once They Are Built / Installed
- ▶ Performance and Life Expectancy of Electrical Systems Decline With Environmental Conditions, Overload Conditions, and Excessive Duty Cycles
- ▶ Principal Reason For Electrical System Failure Is Failure To Maintain
- ▶ Dependable Designs Require Maintenance To Keep Them Dependable:
- ▶ The Risk of An Unscheduled Electrical Failure Can Be Reduced By 66% With An Effective Preventative Maintenance Program - (HSB 2010)

[illegible]

Statistics

Top Causes of Electrical Distribution System Failure

Loose Connections / Parts	30.3%
Moisture	17.4%
Line Disturbance (Other Than Lightning)	10.4%
Defective / Inadequate Insulation	9.9%
Lightning	8.1%
Foreign Objects / Short Circuiting	7.3%
Collision	3.9%
Overloading / Inadequate Capacity	2.4%
Dust / Dirt / Oil Accumulation	2.2%
All Other Causes	8.1%

Failures Based on Hartford Steam Boiler Claims Data

Benefits of Electrical Preventive Maintenance

- ▶ **Improves Safety For Facility and Technicians:**
Provides assurance that protective devices will function safely clears fault conditions.
- ▶ **Provides Higher Level of Reliability / Dependability:**
Reduces Risk of Equipment / System Failure
- ▶ **Strengthens Operational Learning / Training of Electrical System**
- ▶ **Enables Equipment / System To Operate At Peak Efficiency**
- ▶ **Assists With Diagnostic / Troubleshooting**
- ▶ **Controls Equipment Repair / Replacement Expenses**



Fundamentals of Electrical Preventive Maintenance

► Keep It Tight

1. Vibration, Expansion / Contraction of Components with Load
2. Increases Contact Resistance, Produces Abnormal System Reactions
3. Requires Exposure To Arc-Flash Hazard
4. Tighten To Manufacturers Recommendations



Fundamentals of Electrical Preventive Maintenance

► Keep It Dry

1. Humidity, Condensation, Chemicals, Oils, Etc.
2. Accelerates Oxidation Process, Increases Contact Resistance, Shorts Equipment
3. Lint-Free Rags
4. Cleaning Agent



Fundamentals of Electrical Preventive Maintenance

► Keep It Clean

1. Dirt, Dust, Lint, Chemicals, Metallic Particles, Oils, Etc.
2. Clogs Equipment Cooling Means, Creates Fire Hazards, Increases Contact Resistance
3. Lint-Free Rags
4. Cleaning Agent
5. NEVER Use Compressed Air
6. Washable Filters Shall Be Dry Before Being Placed In Service



Fundamentals of Electrical Preventive Maintenance

- **Keep It Friction Free**

1. Prohibits Operation of Equipment, Increases AF Hazard, Increases Contact Resistance
2. Non-Flammable, Non-Corrosive to Electrical Materials

- **Other Fundamentals - Cover All Holes / Unused Penetrations**

1. Arc-Flash Hazard from Falling Foreign Objects
2. Foreign Animals (Ants, Rats, Squirrels, Snakes, etc.)



Fundamentals of Electrical Preventive Maintenance

► Safety Practices

1. Generate detailed method of procedure
2. Qualified Personnel as Electrical System Coordinator (ESC)
3. Conduct Procedural Overview / Safety Meeting Prior to Work
4. All Procedural Tasks Shall Be Directed By The ESC
5. No Equipment Shall Be Energized or De-Energized Without ESC Approval
6. No Equipment Covers Shall Be Removed Without ESC Approval
7. Mark All Equipment That Remains Energized and/or De-Energized
8. Utilize Proper Personal Protective Equipment (PPE)



Electrical Maintenance Safety Signs and Symbols

- Electrical Equipment Signs
 - Danger Main Switch Sign
 - Danger Live Conductor
 - Electrical Equipment Authorized Only Sign



• Overhead Power Line Signs

- Danger Power Lines Above Sign
- Keep Boom Away From Power Lines Sign
- Electrocution Hazard Keep Clear Sign



• **Electrical Room Signs**

- Electrical Room Authorized Only Sign
- Danger Switch room Authorized Only Sign
- High Voltage Electrical Room Sign



● Electrical Hazard Signs

- Electrical Hazard Authorized Only Sign
- Electrical Hazard Keep Out Sign
- Danger Electric Fence Sign



● Personal Protection Signs

- Stop PPE Required Beyond This Sign
- No Hard Hats No Work Sign



● Safety Awareness Signs

- Safety First Work Safely Sign
- Eye Protection Required Sign
- Safety First Watch Your Step Sign

