



Global EHS - Electrical Safety Standard

CONTROL INFORMATION

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1 Purpose

This document specifies the safety requirements for the design, procurement, installation, operation and maintenance of an electrical system and all its associated equipment for power distribution, power conditioning and power generation (back up/renewable) within all Micron worldwide Manufacturing and Non-Manufacturing sites.

The procedures and requirements outlined in this document describe the minimum safe work practices, conditions and expectations for sites to protect Micron team members, contractors and vendors from hazards associated with electricity usage and electrical work activities within a Micron facility.

This standard is intended to ensure that applicable local electrical authority regulations, national and international codes and Micron specification and EHS requirements are complied with during the design, installation, operation and maintenance of all electrical equipment. If the authority regulations and local codes are more stringent than Micron Standards, then those authority regulations and local codes must be followed in all cases.

2 Scope

Items	Details
Site(s) Impacted	All worldwide Micron manufacturing and non-manufacturing sites.
Target Audience	Global EHS, Site EHS, GFTT, FCT, Site facilities team members, Equipment owners, Procurement team members, Tool install team members, Construction team members, Equipment vendors and Contractors at all manufacturing, non-manufacturing and construction sites.
Applicability	This document applies to all new and existing electrical power distribution equipment supporting semiconductor manufacturing, test and assembly, laboratory, utilities, building and facilities systems having a connection to an electrical branch circuit for voltage greater than 50 Volts AC (rms) or 100 Volts DC. This document also applies to all equipment using electrical power in the manufacturing, test and assembly, lab, building services and facility support operations having a connection to an electrical branch circuit for AC voltage greater than 50 Volts AC (rms) or DC voltage greater than 100 Volts DC. This standard is not applicable to systems and equipment using extra low voltage of less than 50 Volts AC (rms) or less than 100 Volts DC. NOTE: The criteria listed above are for general guidance only.

3 Roles and Responsibilities

Roles	Responsibilities
Global EHS	- Maintain, review and update this standard biennially or as needed. - Work with other corporate organizations such as Global Facility Technology Team (GFTT), Facilities Central Team (FCT), site EHS and Procurement teams to communicate EHS expectations to Team members, General Contractors / contractors and vendors. - Review Nationally Recognized Testing Laboratory (NRTL)/ European Compliance (CE) approvals, test reports and equipment safety evaluation reports provided to Micron as part of procurement, GFTT and FCT documentation systems

Roles	Responsibilities
Site / Construction EHS	- Review risk assessment and risk control measures for high risk electrical activities. - Participate in scheduled design review meetings as appropriate or through other means of communication acceptable to the design team. - Communicate EHS safety requirements to the construction, equipment and facilities teams working on Electrical equipment and system including training. - Ensure that the vendors and contractors are trained on site electrical safety documents and practices. - Coordinate requisitions for EHS information from contractors and vendors - Work with facilities team for the minimum guidelines based on local Electrical licensing and local authority regulations. - Provide EHS safety input to installation designs - Review the requirements and subsequent changes of this standard and identify actions to ensure the requirements are effectively implemented - Evaluate continuous compliance to the updated requirements of this standard at least once every 3 years or more frequently (when risk of noncompliance is present) and implement actions to correct deficiency(ies) identified during the compliance evaluation process
Global Facilities Technology Team	- Incorporate EHS safety requirement into Global Electrical Design Specification document. - Ensure EHS safety standard requirements are captured in electrical system design and construction of new green field projects.
Site Facilities Electrical Team	- Ensure that the site Electrical system and all its associated equipment are safely operated, monitored and maintained as per Micron procedures and local authority regulations. - Ensure EHS representatives are included in design, operation and maintenance activities including permit to work and risk assessment reviews. - Maintain tools, equipment and PPE in good working condition and required quantities. - Documentation and drawings are updated and maintained. - Coordinate with vendor on product support matters as required. - Comply with recordkeeping requirements for facilities Electrical records - Track authority regulation changes that could affect electrical safety requirements
Qualified Electrical Person	- Carry out design, installation, testing, commissioning, switching, operation and maintenance activities on electrical power distribution equipment in a safe manner in compliance to authority regulations and site electrical procedures. - Carry out risk assessment for all potential electrical hazards and risk control measures for electrical work activities. - Supervise Electrical work activities to ensure safety and authority compliance. - Carry out periodic audit on electrical system installations.
Authorized Electrical Person	- Assist in the design, installation, testing, commissioning, operation and maintenance activities on electrical power distribution equipment in a safe manner under authorization by a qualified electrical person. - Carry out risk assessment for all potential electrical hazards and risk control measures for electrical work activities. - Carryout or supervise Electrical work activities to ensure safety and authority compliance. - Carry out periodic audit on electrical system installations.

Roles	Responsibilities
Construction Superintendent or Construction Manager or Equipment Install Team manager or supervisor	- Coordinates testing and verification of the equipment safety requirements and safety features. - Verify that all appropriate warning and hazard labels are in place - Ensure EHS representatives are included in design, installation testing and commissioning activities including permit to work and risk assessment reviews. - Ensure the contractors and vendors are trained on site electrical safety procedures and practices. - Ensure that the safety requirements and other regulatory requirements are adhered to during equipment procurement, installation and commissioning. - Ensure completion of punch list items
Facilities Central Team (FCT)	Review the safety requirements as per this standard and support site electrical team in the safe operation and maintenance of electrical system and equipment.
Electrical Contractors / Equipment vendor	- Carryout risk assessment for all potential hazardous systems and associated risks during design, equipment installation, testing and commissioning. Appropriate control measures shall be put into place for all the identified risks from the risk assessment study. - Ensure that the equipment is designed, installed and commissioned in full compliance to local legal requirement, Electrical codes, Micron standards and site EHS procedures. - Ensure all the safety functions, interlocks and other requirements as per law, local codes and EHS standards and site procedures shall be provided for and all safety functions are successfully tested/verified during factory testing and site commissioning. All inspection and test results are documented and submitted to Micron. - Submit any deviations or non-compliance list to this standard as part of vendor submissions to procurement and construction team.
Procurement	Incorporate the requirements of this standard into the procurement process including documentation, vendor negotiations and contract award.

4 Terms and Definitions

Terms	Definitions
ATEX	Appareils destinés à être utilisés en ATmosphères EXplosives (Equipment for potentially explosive atmospheres) ATEX directive covers health and safety requirement for equipment intended for use in potentially explosive atmospheres in the EU market.
CCC	China Compulsory Certification
CE	Conformité Européene (European Compliance) The CE marking or formerly EC mark, is a mandatory conformity marking for certain products sold within the European Economic Area (EEA) since 1993.
CoHE	Control of Hazardous Energy CoHE is a fatality prevention safety program that, when applied properly, prevents serious incidents, injuries and fatalities when Micron team members, contractors or vendors perform service or maintenance activities on equipment. Refer to LOTO.
EHS	Environmental, Health and Safety

Terms	Definitions
ELV	Extra Low Voltage Voltage level not exceeding 50 V ac(rms).
FCT	Facility Central Team The Fab Central Team now includes the backend (assembly & test) operations. It is also known as OCT.
FMEA	Failure Mode and Effects Analysis A method used to proactively assign risk scoring to a system (machine, assemblies, sub-assemblies and parts). FMEAs produce RPN.
GFTT	Global Facilities Technology Team
HV	High Voltage Voltage level exceeding 1000 V ac(rms).
IEEE	Institute of Electrical and Electronics Engineers
JEC	Japanese Electrotechnical Committee
JEMA	Japan Electrical Manufacturer's Association (JEMA)
LOTO	Lockout/Tagout Lockout-tagout (LOTO) is a safety procedure which is used in industry to ensure that dangerous machines are properly shut off and not able to be started up again prior to the completion of maintenance or servicing work. Refer also to CoHE.
LV	Low Voltage Voltage level between 50 V ac(rms) and 1000 V ac(rms)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
OSHA	Occupational Safety and Health Administration A U.S. federal agency created by federal law in 1970 that affects the majority of U.S. employees by setting safety and health standards in the workplace and enforcing compliance.
PCC	Point of Common Coupling Point at which where site power connects to the utility electrical supply.
POC	Point of Connection The physical location where the equipment connects to the facilities electrical source.
PPE	Personal Protective Equipment Any of a series of specialized devices, clothing or equipments worn by employees for protection against hazards. PPE includes anything from gloves to full-body suits with self-contained breathing apparatus.
PSE (DENAN)	Product Safety Electrical Appliances and Materials (Japan)
RA	Risk Assessment A procedure through which knowledge and experience of design, use, incidents and accidents and harm are brought together to measure risks for specified scenarios of the equipment being assessed. Risk assessment includes determining the limits of machinery, hazard identification, and risk estimation. It is the process of evaluating the risk(s) arising

Terms	Definitions
	from a hazard(s), taking into account the adequacy of any existing controls, and determining whether or not the risk(s) is acceptable.
SEMI	Semiconductor Equipment and Materials International An industry association that promulgates standards relating to the manufacture of semiconductor equipment. The “S” series of documents specifies EHS criteria that semiconductor equipment shall comply to.
UL	Underwriter Laboratories
UPS	Uninterruptible Power Supply Electrical apparatus that provides emergency power to a load when the input power source or mains power fails, typically for critical systems in the fab.

5 References

Internal References	Link
Global EHS - Control of Hazardous Energy (CoHE) Standard	2W4373RQWREN-1568922467-29
Global Facilities - Electrical - Electrical Design Standard Specification	A3YRXSD74VDV-57553043-388

External References
ATEX Directive 2014/34/EU
NFPA 70 – National Electric Code
NFPA 70E – Standard for Electrical Safety in the Workplace
NFPA 79 – Electrical Standard for Industrial Machinery
OSHA 29 CFR 1910.302 – 308 Design Safety Standards for Electrical Systems
OSHA 29 CFR 1910.331 – 335 Electrical Safety Related Work Practices Standards
OSHA 29 CFR 1926.400 – 449 Electrical Safety Requirements for Construction Work
PSE (DENAN) – Product Safety Electrical Appliances and Materials (Japan)
SEMI S2 - Environmental, Health and Safety Guideline for Semiconductor Manufacturing Equipment
SEMI S10 – Safety Guideline for Risk Assessment and Risk Evaluation Process
SEMI S22 – Safety Guideline for the Electrical Design of Semiconductor Manufacturing Equipment
SS 638 – Code of Practice for Electrical Installations (Singapore Standard)

6 Standard

6.1 Legal Requirements

- Site electrical team shall ensure that all electrical system installations and electrical work activities comply with local electrical authority regulations and the local or international electrical codes as appropriate.
- Sites shall be aware of legal and electrical licensing requirements associated with operation and maintenance of site electrical installation and shall ensure that all such requirements are properly communicated to impacted stakeholders, including contractors. All legal and licensing requirements shall be periodically audited by a qualified electrical person.

6.2 Micron Requirements

- In addition to the legal requirements, Site Electrical team shall also ensure that all electrical system installations and electrical work activities comply with site insurance requirements, Micron specification and EHS standards.

6.3 Qualifications of Personnel Working on Electrical System

6.3.1 Unqualified Electrical Person

- A person who is not knowledgeable of the construction and operation of electrical Equipment and are not trained to recognize Electrical Hazards. Unqualified personnel must complete upon hire or assignment to a Micron site the relevant electrical safety training as applicable to the specific site. Unqualified persons shall be familiar with any electrical safety related practices as needed for their personal safety.

6.3.2 Qualified Electrical Person

- Person who is knowledgeable of the construction and operation of equipment or a specific work method that they are to work on and trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.
- A qualified person shall be familiar with the applicable electrical policies, local authority regulations, codes and safe working procedures including risk assessment and risk control measures including proper usage of PPE.
- Micron team member or contractor personnel holding valid electrical licenses issued by local authorities are considered qualified electrical person to carry out electrical work and switching activities within those licensing terms.
- Qualified Electrical Persons shall have the necessary skills and knowledge in carrying out safe Electrical work and at a minimum must complete, or show completion certificates for, the following trainings:
 - NFPA 70E Electrical Safety in the Workplace, or local equivalent
 - National Electric Code Update every 3 years, or local equivalent
 - Global Facilities - Electrical Safety Program Electrical Safety Program (eLRN 139177)
 - Global EHS - Control of Hazardous Energy (CoHE) Training (eLRN 1186486)
 - Any other requirement as mandated by the local authorities or by the Micron local site.
- A worker who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a qualified person and who, in the course of such training, has demonstrated and documented an ability to perform specific duties safely at his or her level of training

and who is under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those specific duties, when permitted under local authority regulations.

- A person may be qualified for certain equipment, task and voltage levels and still be unqualified for other equipment, task and voltage levels.

6.3.3 Authorized Electrical Person

Where legally allowed, electrically trained Persons can be designated as Authorized Electrical Person by a qualified electrical person to carry out Electrical work including electrical system operation and maintenance activities.

- Authorized Electrical Person must be knowledgeable of the construction and operation of equipment or a specific work method that they are to work on and must be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.
- An authorized person shall be familiar with the applicable electrical policies, local authority regulations, codes and safe working procedures.
- Such person shall be familiar with electrical hazard and risk identification and risk control / mitigation measures including safe electrical work practices and PPE usage.
- Authorized Electrical Persons shall have necessary skills and knowledge in carrying out safe Electrical work and at a minimum must complete, or show completion certificates for, the following trainings:
 - NFPA 70E Electrical Safety in the Workplace, or local equivalent
 - National Electric Code Update every 3 years, or local equivalent
 - Global Facilities - Electrical Safety Program (eLRN 139177)
 - Global EHS - Control of Hazardous Energy (CoHE) Training (eLRN 1186486)
 - Local authority courses such as Low Voltage / High Voltage operation, Electrical testing, Relay protection, Explosion proof electrical work, Cable jointing where available.
 - Any other requirement as mandated by the local authorities or Micron site.
- A person may be authorized for certain equipment, task and voltage levels and still be unauthorized for other equipment, task and voltage levels.

6.3.4 Training Matrix

The following matrix is a visual representation of the training required in sections 6.3.1 through 6.3.3:

Table 1 Training Matrix

Training	Unqualified Electrical Persons	Authorized Electrical Persons	Qualified Electrical Persons
Global EHS - Control of Hazardous Energy (CoHE) Training (eLRN 1186486)	X	X	X
Global Facilities - Electrical Safety Program (eLRN 139177)		X	X
NFPA 70E Electrical Safety in the Workplace, or local equivalent		X	X
National Electric Code Update or local equivalent		X *renewal required every 3 years	X *renewal required every 3 years
Local mandatory Training for Qualified Electrical Person			X

6.4 Design

- The electrical system and all its associated equipment design shall conform to electrical safety requirements under local electrical regulations, national and international codes, Micron specifications and EHS procedures.
- At design stage, the contractor / vendor shall assess all hazards and potential risks associated with the construction, operation and maintenance of the equipment. Adequate risk control /mitigation measures shall be incorporated into the design to mitigate those identified risks.

6.4.1 Equipment Design

- All high voltage switch gears and low voltage switchboards shall be of type tested design. High voltage, Low voltage and DC system shall be built with arc flash containment features. Electrical power and distribution equipment including, switchboards, transformers, busways, drives and breakers and power cables shall have test certificates from NRTL / CE / JEC / CCC or equivalent locally accredited testing laboratory for the same model and rating. Electrical equipment, parts, components and cables shall be designed and sized with safety margin as per Micron specifications.
- Partitions or barriers shall be provided to the low voltage switchgear assemblies to obtain a form 4b separation to protect employees against contact with adjacent energized circuit parts. Form 3b is only acceptable if all terminals have a degree of protection of at least IP30.
- To improve safety of switchboards during installation, operation and maintenance, latest available safety features shall be considered for inclusion into the equipment design and panel construction. These features include:
 - Protection relays with Arc Flash Energy Reduction Maintenance (AFRM) settings which will set the protection to the fastest tripping mode thereby lowering arc flash energy level.
 - Improved design with arc flash venting. The arc flash energy thus generated will be routed to a safe exit without harming the operator.
 - Switchboard designed and built with arc flash withstand capabilities to prevent structural collapse.
 - Remote breaker rack in / rack out feature or with selectivity setting maintenance mode where the arc flash incident energy exceeds currently available arc flash protection.
- The contractor shall ensure that the electrical equipment, parts and components are installed in accordance with manufacturer's recommendation and within the conditions of the certification.
- The temperature class of insulation materials in the equipment shall be rated higher than the expected equipment operation temperature.
- All electrical system equipment, panels and equipment connected to electrical power shall be protected against overcurrent and short circuit. The circuit breakers and electrical components shall be able to withstand expected short circuit fault current without damages or fire. Protection devices and its settings within the electrical power distribution shall be coordinated for selectivity and protection discrimination.
- The ON and OFF position shall be clearly marked against the respective breaker handle positions.
- All electrical equipment enclosures shall be protected against liquid and dust ingress as per NEMA / EN / JEM or equivalent local standards. All incoming cable entry to the equipment enclosure shall be sealed through glanding or equally acceptable methods. Cables routed internally shall be grommeted when going through enclosure openings. The contractor shall ensure that all electrical equipment is installed in an environment free of corrosive/reactive gas and chemicals. Electrical equipment and installations shall be protected against rodents, animals, birds and other insects.
- When a UPS is installed, all relevant UPS drawings and UPS and battery maintenance instructions are included in the equipment documentation. The UPS shall be factory tested for key performance parameters.

- Large capacitors with diameter greater than 25.4 mm (1 Inch) or with an energy storage capability of 4 Joules shall be self-vented or protected against rupture. Capacitors shall be provided with a containment option to prevent vapors and debris posing a hazard to personnel, in case of rupture.
- The contractor shall ensure that all electrical energy storage components like lead acid and lithium-ion batteries are rated for its purpose and certified by an authorized testing laboratory. The contractor shall include recommended monitoring and maintenance instructions including storage, use, charging, maintenance, room temperature and ventilation requirements and safe disposal in the operation and maintenance manual. The charging of batteries shall be done by only manufacturer authorized battery charger or charging circuit.
- All exposed terminals, cable and busbar terminations shall be protected by insulated covers or barriers. Insulated phase separators shall be provided for cable terminations at molded case circuit breakers (MCCB) and disconnects (isolators) to prevent short circuit between phases and phases to earth.
- The main incoming equipment breaker (Isolator/disconnect) shall be interlocked with the electrical enclosure door opening. The enclosure door can be opened only when the equipment incoming breaker is in the off position. Door open interlock can be defeated, by a special tool, for maintenance access when necessary and to be carried out by a qualified / authorized electrical person only.
- All power and control cables shall be terminated using cable glands / lugs and at the recommended torque. Cable entry shall be from the bottom is preferred for all wall mounted distribution boards / panels.
- Electrical equipment shall be designed to control exposure to noise level below 80dBA (continuous) or below 120 dBA (instantaneous).

6.4.2 Grounding / Earthing and Lightning protection

- The protective earth shall be bonded/effectively grounded to equipment frame, equipment metal parts and the electrical earth (ground) point. The metallic cable support system and cable glands shall also be electrically bonded / connected to the equipment frame / earth (ground) point. Electrical continuity shall be provided and maintained between the protective earth source, equipment frame, metal parts, the cable support system and verified during the equipment commissioning.
- Lightning protection shall be provided to all buildings and Micron site facilities as per local codes and Micron requirements. Lightning protection shall also be provided during the construction stage.
- The equipment short circuit rating shall be higher than the calculated fault current level at the point of connection.

6.4.3 Work Safety (CoHE / LOTO)

- The local disconnect / field isolator where the incoming power to the equipment is terminated should have provisions for lockout tagout (LOTO) as per Micron CoHE standard. Where the same equipment receives multiple external electrical power feeds, all the respective breakers/disconnects (isolators) shall have LOTO provision. LOTO labels are to be provided at the respective breakers and Disconnects (Isolators). Labels indicating the power source panel name, feeder or circuit tag and location details are to be provided at the equipment main incoming breaker and local disconnect / isolator for easy identification and isolation purposes.
- The main breaker receiving external power to the equipment or the equipment local disconnect (isolator) preferably shall be of 4-pole type for 3-pole + N + grounding supply and 3-pole type for 3-pole + grounding supply. This is to ensure no back feed of neutral current to the equipment ground(earth) during equipment maintenance and service activities.
- By design, the contractor / vendor shall minimize the need to access and carry out testing, servicing, maintenance and modification works on the equipment when it is in an energized condition. The need to work near energized components or circuits shall be eliminated as much as possible to avoid

electrical power interruption and electrical hazards. Infrared view glass or alternate new solutions may be provided on electrical switchboards to facilitate infra-red scanning without the need for opening a live panel / compartment. Any energized circuit with a potential exposure to a voltage of more than 50 V ac in a dry location will be considered as an electrical hazard condition to humans. Where routine work needs to be carried out in such cases, the equipment manufacturer / contractor / qualified electrical person shall provide specific written instructions for the work including recommended PPE.

6.4.4 Electrical Switch Room Requirements

- Switch room at all sites are to be well maintained with restricted access to only qualified / Authorized person. Unqualified electrical personnel access to the switch room such as safety, Security, cleaners' visitors must be accompanied by qualified / authorized electrical persons. Switch rooms doors shall be kept locked. Danger and restricted entry notices shall be provided on the door to warn against unauthorized entry.



Figure 1 Warning Label - Electrical Hazard

- Fire extinguisher suitable for fighting electrical fires shall be kept in all Electrical switch rooms. All penetrations on the switch room wall shall be sealed with fire rated material. Rooms designed as electrical rooms shall not have storage of any combustible materials or equipment. Routing of liquid carrying pipes shall be avoided through switch rooms housing Electrical panels. Electrical switch rooms shall have smoke detectors under building fire alarm monitoring system. An updated electrical single line / one-line drawing shall be maintained in the Switch room.
- The switch room shall be provided with a PPE cabinet with the required PPE. Adequate clearances around the equipment and panels shall be maintained as per Micron specifications, local regulations and equipment manufacturer guidelines.

6.4.5 Harmonics

- Electrical equipment shall be designed to ensure that the harmonics generated in the electrical system are within limits at the point of common coupling (POC) as per international standards. Harmonics filters shall be incorporated, where required, into the system based on harmonics level studies to mitigate the effects of harmonics.

6.4.6 Lighting

- The lighting system to the facility shall be designed to ensure that quality illumination is provided to internal and external areas at the Micron site. The illumination level shall be designed to meet Micron lighting level requirements and as per local codes. A complete room by room illumination

measurement is to be carried out and recorded to ensure adequate illumination level. Additional lighting shall be installed if the measured illumination level falls short of the design value.

- Illuminated Exit lights, Emergency lighting shall be provided to emergency escape routes, Control rooms, switch rooms, substation and other identified rooms as per Micron and local authority requirements. Illumination shall be provided for personnel to safely carry out work within the facilities area where electrical hazards exists.

6.4.7 Hazardous Areas

- Lighting fixtures, power outlets/receptacles, motors and other Electrical equipment shall be NRTL/ ATEX / JEM certified or by equivalent local authorities for use in the classified hazardous area for the rated ambient temperature. Electrical installations in classified hazardous areas shall comply to the hazardous area installation requirements.

6.5 Construction

- Construction electrical activities shall be carried out by qualified / authorized electrical personnel with approved permit to work, risk assessment, risk control / mitigation measures and required PPE. General workers assisting in the Electrical installation work shall be supervised by a qualified electrical person.
- All construction workers shall undergo site / Micron EHS training prior to working at a Micron site.
- A qualified electrical person or contractor licensed by the local authorities, where applicable, shall be engaged by the electrical contractor to carry out the electrical work such as:
 - Ensuring compliance of electrical design and equipment installation safety as per legal, local authority regulations and Micron specifications and EHS requirements.
 - Carry out safe electrical switching under license terms
 - Carry out electrical and equipment testing and commissioning
 - Work with local electrical authorities on all electrical license and installation matters including incident investigations.
 - Review risk assessment and propose control measures for electrical work and switching activities.
 - Review working on live electrical system risk, risk assessment study and propose control measures
 - Periodic inspection of electrical installation including temporary power panels, electrical switch rooms, lighting, grounding (earthing), lightning protection, diesel generator sets. An inspection report shall be submitted to Micron for record.
- All hand tools including screw drivers for electrical work shall be fully insulated and in good working condition.
- Contractors shall ensure that all measurement instruments used for testing and commissioning purposes are calibrated with a valid calibration certificate.
- All portable electrical tools for construction work shall be in good working condition, periodically tested and certified by site electrical team.
- Construction portable tools shall use GFCI/ELCB adaptor prior to connecting to site electrical power. Construction machinery and equipment shall be provided with ground leakage / earth leakage protection.
- Periodic inspection shall be organized together with micron construction manager or his representative, electrical team and EHS team to identify unsafe work and working conditions a few of which are listed below:
 - unsafe work
 - Working without proper PPE

- Non insulated tools
- Electrical tools without ELCB/GFCI protection.
- Using metal ladder instead of Fiber glass Ladder in electrical rooms
- Working without approved permit to work.
- unsafe work condition
 - Work violating CoHE procedure
 - No Safety Barricades/Signages
 - Poor Lighting
 - Missing hazard labels

6.5.1 Hazard Warning Labels

- All Danger notices and Hazard warning labels shall be prominently displayed to identify and warn against potential electrical hazards. The labels shall be in English and the respective site local language, permanent and legible and shall be dictated by law in the respective country.
- Where the equipment receives external power from multiple sources (normal power, UPS power), all such power sources shall be identified and individually labeled. A label shall be provided clearly stating that this machine receives power from multiple sources and all power sources shall be isolated for total equipment power shutdown.
- If some components / terminals are live with hazardous potential even after isolating the main power, such terminals and parts shall be identified with Hazard warning label.



Figure 2 Danger Label - Electrical Hazard

6.5.2 Temporary Lighting and Power

- Temporary lighting shall be provided to the site during construction stage to ensure adequate illumination for carrying out construction activities, people and material movement. The light fittings shall be properly supported and maintained during the required period. All temporary lighting and power design and installation shall be approved by a qualified electrical person.
- Contractor shall design and install the temporary power system and its associated electrical panels and equipment in full compliance to the local codes, Micron standards and site EHS safety requirements.
- Generator set, Distribution panels, power cables and wiring, power outlets shall be designed and sized with electrical safety features including ground fault, short circuit and overcurrent protection. The contractor shall provide cable support design calculations and cable routing layouts for approval. The cable routing and installation shall not obstruction to people and material movements. No cable joints are allowed unless approved.

- Danger signs, hazard warnings labels shall be installed by the contractor as safety alerts. Single line / one-line drawings shall be provided inside the power /lighting distribution boards, electrical panels, and circuits labelled for easy identification.
- All electrical switching work shall be carried out by qualified electrical personnel with skills relevant to the job. General workers assisting in the installation work shall be supervised by a qualified electrical person.
- Contractor shall carry out the installation activities under micron/main contractor approved permit to work and risk assessment requirements.
- Contractor shall dismantle, remove and handover the distribution panels, cables, power outlets, light fittings in a good working condition upon full or partial completion of work or as per Micron request.
- Any unused panel, outlets, light fittings and electrical cables shall be disconnected from power, removed and stored properly when the temporary power requirement is no more required for a certain area.
- For temporary underground electrical installations, suitable safety protection shall be provided to prevent damages during subsequent excavations.
- All electrical equipment used for temporary power shall suitably ingress protected to prevent water and dust ingress. All exposed terminals, cable and busbar terminals shall be protected by insulated covers or barriers. All power, lighting, equipment, cable routing and underground layouts and power distribution drawings shall be provided by the contractor.
- Lightning protection shall be provided to the entire construction site as per Qualified Electrical Person approved design. Electrical Grounding / earthing shall be provided as per approved design. All equipment including DG set, power panels shall be properly grounded / earthed. GFCI/ELCB adaptors shall be used with electrical hand tools while connecting to temporary electrical power.
- All electrical equipment including DG set, Power panels, lighting, grounding (earthing), lightning protection system shall be maintained and inspected regularly by the qualified electrical person on a periodic basis.

6.6 Electrical Equipment Safety

- All Electrical power systems and their associated equipment at Micron sites are to be installed, operated and maintained as per manufacturer procedures, local electrical regulations and Micron requirements.
- Access to electrical panels shall be clear and free of obstacles for a minimum of 3 feet in front of the panel. No materials, furniture, or equipment shall be placed within this zone.
- All electrical equipment shall be protected against overcurrent and short circuit as approved by the qualified electrical person. Electrical equipment shall be provided with suitable warning and trip alarms as required.
- EMO buttons when provided shall be of an electromechanical type with self-latching feature. When activated, EMO buttons shall place the equipment into a safe shutdown condition without generating any additional hazard to personnel or facility. The EMO shall meet the local authority and Micron requirements including local language labelling, EMO guard may be provided to prevent inadvertent operation of the button by personnel or other accidental contact.

6.6.1 Arc Flash Protection

- All installations of electrical equipment shall have an arc flash analysis completed by a trained inhouse electrical engineer or an external engineering firm:
 - At the time of installation, prior to being put into use.

- Upon occupancy of a new building, unless a previous study can be verified to have been completed and is current for all system components at the time of occupancy.
- Upon modification or renovation to an electrical system.
- Every 5 years from the date of last study (US), 4 years (Germany).
- Following any event or incident which damages or otherwise compromises the electrical system, such as but not limited to damage to an electrical panel or exposure of water to the system.
- Any time electrical equipment is found without adequate labelling. In this event, an arc flash analysis must be completed prior to initiation of any work on the electrical equipment in question.
- The arc flash hazard analysis must determine the Arc Flash Protection Boundary and the personal protective equipment (PPE) that personnel within the boundary must use.
- Warning labels shall be provided on all electrical equipment and/or panel doors leading to live electrical parts.
- Electrical equipment such as switchboards, panel boards, industrial control panels, meter socket enclosures, motor control centers, overhead power distribution systems, and power distribution units (PDUs) must be labeled in a manner which is visible from the outside of the box with, at a minimum, the following:
 - Available highest incident energy and the corresponding working distance
 - Minimum arc rating of clothing
 - Required level of PPE
 - Nominal System Voltage
 - Arc Flash Boundary
 - Last Arc Flash Assessment Date

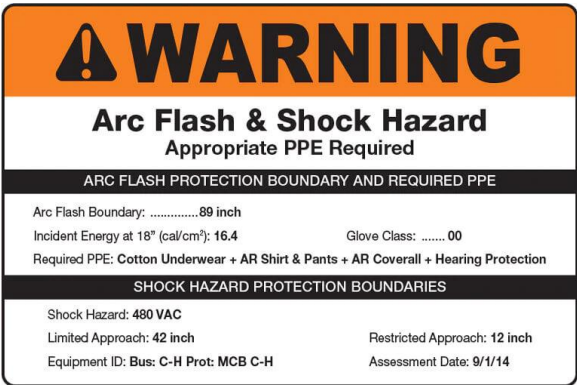


Figure 3 Warning Label - Arc Flash Hazard

6.6.2 Renewable Energy

- Where renewable energy is used at a Micron site, the installation and operation are to be carried out as per local authority regulations, Micron specifications and EHS requirements. Exit staircase or cat ladder access shall be provided for roof top Photo voltaic (PV) installations. Maintenance access shall be provided between PV module arrays. The PV modules shall be certified for fire resistance class as required under local authority regulations. All associated electrical installations shall meet Micron electrical specifications and EHS requirements. Fall protection measures shall be provided around the roof where parapet or railing is not available.

6.7 Operation & Maintenance

6.7.1 Operation

- All electrical systems and associated equipment shall be operated as per its original intended design and Micron operating procedures. Overloading of Electrical components and equipment are not allowed. The electrical equipment shall be monitored for safe operation by qualified/authorized electrical person through periodic site checks. Equipment warning and trip alarms other critical operational parameters shall be remotely monitored, where available, through an electrical monitoring system. All system / equipment parameters to be monitored are to be identified during design stage and linked to the facility / electrical monitoring system for remote monitoring and trending purposes. Adequate redundancy and back up provisions shall be designed into the electrical power distribution system to ensure quick restoration of the electrical system due to a single point failure.
- Safe operating procedures shall be developed for all electrical systems and associated equipment and are to be documented. The manual shall also include detailed drawings, layouts, schematics, list of spare parts and special tools required for safe equipment operation. The operation and maintenance manual completed in all aspects by the contractor / equipment vendor is to be handed over to Micron before system final acceptance.

6.7.2 Maintenance

- All electrical system and associated equipment shall be maintained by qualified / authorized electrical personnel to ensure proper and safe operation of the system and equipment. Predictive and preventive Maintenance procedure shall be developed based on equipment manufacturer recommendations, best industrial practices and Micron procedures. Periodic infra-red scanning, partial discharge measurement, and other preventive / predictive techniques may be applied as relevant to detect early warnings and incipient failures. Periodic inspection checks and maintenance activities carried out on the equipment are to be recorded and documented. Periodic testing and inspection shall be carried out and documented on all applicable facilities systems and equipment as per local authority requirements, Micron procedures and equipment vendor recommendations.
- The contractor / equipment vendor shall provide recommended maintenance procedures, frequency of maintenance and other safe maintenance procedures for the equipment and system under their scope of supply. This shall be included in the operation and maintenance manual.

6.8 Electrical Safe Work Practices

6.8.1 Permits & Risk Assessment

- All electrical works such as testing and commissioning, switching, equipment servicing shall be carried out with approved permit to work as per local authority regulations and Micron requirements.
- A risk assessment shall be carried out by a qualified / authorized electrical person to identify potential electrical hazards and associated risks with the work and working methods. The risk assessment shall include suitable control and mitigation measures to bring down the risk to a lower level. The risk assessment and control measures shall be reviewed and approved by the qualified electrical person's supervisor. Risk control measures shall include administrative controls, elimination, substitution, engineering control measures and PPE.
- If risk assessment has not been documented, then hazards associated with the system and risk control measures must be evaluated and documented by a Qualified Electrical Person prior to any work being performed. Other possible hazards and associated risks due to confined space, working at height and fire protection activation are to be evaluated together with suitable control measures.

6.8.2 Personal Protective Equipment (PPE)

- PPE program shall be maintained at each Micron site to ensure the following:
 - To maintain recommended type and quantity of PPE as required for the expected electrical work for the site.
 - Periodic auditing to ensure the required quantities of PPE are available in good working condition and within service life.
 - Hearing protection shall be provided where the noise level is 80 dBA or above.

6.8.3 Notification of Electrical Hazards Prior To Work

- All personnel, including vendors and contractors, who are to work on or with any systems shall be notified of electrical hazards associated with the system(s) they are to perform work on / with. Notification may be achieved by system labeling, required training, written procedures or documents made available to those affected, and/or verbal notification by a person knowledgeable of the hazards associated with the system.

6.8.4 De-Energization and Equipment Shut Down

- Work on electrical systems of any voltage greater than 50V AC (rms) shall be de-energized prior to commencement of work.
- Any re-energization that involves testing of, or exposure to, live electrical circuitry shall be deemed live Electrical Work.

6.8.5 Control of Electrical Hazards (CoHE/LOTO)

- Micron has implemented a control of hazardous energy (CoHE) program to safeguard workers from exposure to potential hazardous electrical energy including stored energy. Electrical equipment shall be designed, built and installed as per Micron CoHE requirements. Energy isolation devices (like circuit breakers, disconnects / isolators) shall be capable of accepting lock out tag out (LOTO) devices in the OFF position.
- However, the requirement of CoHE is exempted for equipment with a single electrical power source that can be unplugged with no additional energy source and the power cord is under exclusive control of the authorized worker.
- Qualified or Authorized electrical persons shall identify the hazardous electrical energy sources and energy isolation points.
- Wherever possible, Micron shall maintain written procedures for the control of hazards related to specific equipment or work tasks (e.g. Tool Installation Procedures, Energy Isolation Procedures, permit to Work / energized electrical work Program).
 - Initial versions of these procedures must be approved by an EHS representative prior to field use, or as otherwise prescribed by Micron Standards.
 - Any changes to an electrical system that affects written procedures for that system shall cause a required review and update of the procedures.

6.8.6 Working on Live System

- No employee is permitted to work on or near a live electric power circuit that the employee could contact the live power circuit in the course of work, unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means.
- For the electrical construction, operation, maintenance / repair work done in the US, reference shall be made to the OSHA standards on electrical safety requirements for regulatory compliance.

- Working on live electrical system with voltage of 50 Volts AC (rms) or more is to be avoided and carried out only when it is justified with site inspection and risk assessments. In such cases, the following precautions are to be ensured.
 - Work to be carried out by qualified/authorized electrical person only.
 - A qualified person shall complete the risk assessment and risk control / mitigation measures including PPE requirement.
 - A permit to work / Energized / live Electrical Work permit is to be completed by qualified / authorized person with supervisor approval.
 - PPE requirements identified during risk assessment must be worn prior to starting the work. All PPE required as per risk assessment is worn, insulated tools are in use as needed, approach boundaries are established, watch person(s) are readily available, and other controls are 100% maintained. All controls must meet local regulatory requirements.
 - In the absence of Arc flash study and zone marking, the Qualified Electrical Person will conduct an arc flash hazard assessment to determine the appropriate PPE and approach distances and boundaries for shock and arc flash protection. Results of the assessment must be reviewed with all impacted workers prior to beginning work. All workers must be in agreement that the work can be performed safely prior to proceeding.
 - A physical copy of the permit to work / energized electrical work permit must be available at all times at the site where electrical work is being performed. Upon completion of work, a copy of the permit shall be maintained according to the recordkeeping requirements outlined in Section 6.11 Recordkeeping.
 - An estimate of the likelihood of an Arc Flash Incident on typical electrical work is available under table 130.5(C) of NFPA 70E.
 - Reference shall be made to Table 130.5(G) of NFPA 70E for the selection of Arc Rated Clothing and other PPE requirements based on incident energy analysis method.
 - Where it is possible to reduce the fault clearing time through protection relay settings changes, such options shall be considered to reduce the arc flash energy where such setting changes do not compromise the relay coordination and electrical protection.
 - The work shall be full-time supervised by a qualified / authorized electrical person. (Two-person rule or buddy system).

6.8.7 Tools and Instruments

- All electrical tools and power tools shall be maintained in good working condition.
- Hand tools used for electrical work shall be insulated type.
- All testing and measurement instruments shall be maintained in good working condition with a valid calibration certificate.
- All outside electrical tools when brought in by contractors / vendors shall be tested for safe operation and free of damages. Such tool when plug in to Micron receptacle / power outlet shall be done only through GFCI or ELCB adaptor.

6.9 Lithium – Ion Battery and Personal Device Charging

- Lithium – Ion batteries store energy and supply power to many devices like phones, laptops, tablets and e-scooters. They store a large amount of energy and if not used properly or are defective, the battery can overheat, catch fire or explode.
- The following safety practices are to be followed while using batteries including Lithium – Ion batteries:
 1. Ensure that the battery is from an original manufacturer.

2. Use the battery as per manufacturer instructions.
 3. Do not keep charging the battery after it is fully charged.
 4. Do not charge battery below 0°C (32°F) or above 40°C (105°F) ambient.
 5. Do not charge or store battery in hazardous rooms or less than 3m(10 feet) to flammable materials.
 6. Avoid exposing the battery to excessive shock or vibration.
 7. Ensure that the battery is free of damages like bulging, cracks or leaks.
- Personal devices and equipment having batteries should be not charged unattended except for charging buggy / forklift, gas detection equipment and laptops.
 - Battery disposal shall be done properly at allocated battery disposal areas and not to be disposed into the general waste.
 - Battery charging of personal mobility devices such as electric scooters, electric bicycles, unicycles, hoverboards (PMD) are not allowed at site **except for company issued mobility devices. For company issued E-bikes and other mobility devices, dedicated battery charging stations are to be installed at outdoor locations external to manufacturing, lab and office buildings. Provision shall also be made at such external locations for charging other Li-Ion battery tools such as lifting and material handling tools, where possible.**
Where Li-Ion battery charging is still required in certain locations within the building due to operational reasons, additional fire detection and protection measures are to be implemented at the battery charging locations based on fire risk assessments.

6.9.1 Personal Electric Heaters, Air Conditioners, Cooling Fans, & Personal Use Equipment

- Team members, Contractors and Vendors bringing personal equipment to site should first consult site facilities electrical engineer for approval for connecting to Micron electrical network. Equipment that is powered by cord and plug must have a grounding plug installed or be double insulated with NRTL / CE certified label.
- All cords and plugs must be free of damage and excessive wear.
- Personal electric heaters, including heating blankets, are not permitted for use at Micron facilities unless granted by, and set up, by site Facilities electrical team.
- Air conditioners operated by plug and cord are not permitted for use at Micron facilities unless approved by and set up by the site Facilities electrical team.
- Micron Team Member / Contractor / Vendor bringing personal equipment such as cooling fan, coffee machines must get approval from site facilities team to connect to power sockets to ensure the circuits are no overloaded and no earth /ground leakage.

6.9.2 Testing of Computer Systems and Components

- All permanent and temporary computer testing set ups designed to test computer systems and/or components shall be constructed by an Authorized Electrical Person using non-flammable, non-conductive, materials.
- No permanent or temporary computer testing set ups over 50 volts are permitted to be constructed, unless done so by a Qualified / authorized Electrical Person.
- The total current loading / pulling of all computer testing set ups on a single circuit must not exceed the capacity of that circuit.
- Any components of a computer testing set up that have exposed electrical circuitry must be guarded or insulated against inadvertent contact by personnel or equipment.

6.9.3 Electrical Power Strips and Extension Cords

- Extension cords shall be issued by or used only with approval from site facilities team for temporary purposes not exceeding the duration of the work to be performed.
- Power strips must be used in a manner which does not exceed its capacity.
- Power strips shall not be plugged into any other power strip (daisy chain) or splitter.
- Extension cords and power strips shall be inspected on a regular interval of 1 year by qualified / authorized electrical personnel.

6.9.4 Electric Vehicle Charging

Electric vehicle charging is allowed at designated vehicle charging stations within Micron facilities subject to the following conditions:

- Battery and charging equipment shall be original and from the authorized vehicle dealer / manufacturer.
- The charging of the battery shall be done strictly as per manufacturer charging instructions.
- Mobile battery charger shall be UL or certified by equivalent local testing laboratories.
- The charging station and outlet type shall meet the local authority charging regulations with relevant test certificates and tested by an accredited testing laboratory.
- To eliminate the potential risk of fires associated with battery and its charging, installation or operation of EV charging stations are prohibited inside the building or underground carparks.

6.10 Housekeeping

- Team members, contractors, vendors performing electrical work shall keep the work area clean, dry and free of debris. Work area shall be barricaded with danger notices to warn and prevent unqualified personnel access to the work area. All debris and waste material generated shall be disposed properly at designated waste disposal areas.
- Housekeeping duties should not be performed when energized parts present an electrical contact hazard, unless safeguards, such as barriers and insulating equipment, are provided.
- Do not use electrically conductive cleaning materials (steel wool, metal cloth, silicon carbide, conductive liquid solutions like ammonia) near energized parts.

6.11 Electrical Safety Auditing

Periodic safety audit is to be conducted by a qualified / authorized electrical person to ensure compliance to authority license terms, NFPA 70E or local equivalent and Micron requirements on the electrical system

- Identify unsafe working and working conditions.
- Identify unsafe electrical installations
- Identify violations to electrical installation code, legal requirements and Micron requirements.
- Audit field electrical work to verify that the electrical safety program and procedures are followed.

6.12 Recordkeeping

Records related to the electrical safety program will be retained in accordance with the following schedule:

- Training records shall be retained for at least 5 years, or as required by local regulation.

- Energized Electrical Work Permits / permit to work shall be retained by the facilities Electrical department for 1 year, or as required by local regulation.
- Records of Contracted Electrical Work shall be retained by Micron Facilities for after employment termination + 7 years.
- All records related to an employee exposure to electrical hazards that caused injury shall be retained by Micron EHS for after employment termination + 30 years.

7 Appendices

Nil

8 Document Control

Items	Details
ECN Facility	CORP EHS
ECN Area	EHS SAFETY
Approval	This document is approved by: GLOBAL_EHS_SEAL_LT
Notification	Notification of changes to this document is managed through Micron’s Engineering Change Notification (ECN) process to the following: - GLOBAL_EHS - GLOBAL_EHS_MANAGERS - GLOBAL_EHS_SEAL_LT - GLOBAL_EHS_TEAM_MEMBERS - GLOBAL_FAC_MANAGERS - GLOBAL_FAC_NOTIFY
Review	This document will be reviewed at least biennially (once per two years) by Global EHS / PSM through the Periodic Document Review (PDR) process.

9 Revision History