



**ARCHITECTURAL/ENGINEERING BULLETIN**

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Bulletin Topic: **Arc Flash Hazard Analysis Study and PPE Label Requirements**

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**GENERAL:**

This A/E Bulletin sets forth requirements for both Design-Bid-Build and Design-Build projects of any size, which include any electrical scope of work. The bulletin provides for the inclusion/implementation of an Arc Flash Hazard Analysis Study and the furnishing of Arc Flash Hazard Equipment Labels including the specification of the appropriate PPE level.

**BACKGROUND:**

The Los Angeles Community College District seeks to ensure a level of safety at each of their campuses and facilities. In an effort to achieve this objective, all projects of any size that include any electrical scope, will be required to perform an Arc Flash Hazard Analysis and develop an Arc Flash Hazard Labeling Equipment Plan with indicated PPE requirements pursuant to NFPA and OSHA requirements.

This bulletin will outline the requirements for the A/E consultants, Contractors and Design-Builders for subject projects. The Bulletin will be organized by delivery type for **Design-Bid-Build** (A/E Consultants and Contractors) and **Design-Build** (Design-Builders) project procurements.

## **PROTOCOL FOR IMPLEMENTATION:**

### **A. Design – Bid –Build Projects**

- i. Designers – Consultants, as part of their professional services agreement, will be required to provide the work scope described via **Exhibit A** of this Bulletin. This work scope outlines the requirements for the Arc Flash Hazard Analysis Study (and other requirements as indicated) to be provided by the subject consultant and the associated Arc Flash Hazard Equipment Labeling requirements to be incorporated into the project plans and specifications.
- ii. Contractors – Contractors as part of their construction contract will be required to furnish Arc Flash Hazard Equipment Labels as indicated/required per the project plans and specification and per the guidelines of **Exhibit B** of this Bulletin.

### **B. Design – Build Projects**

- i. Design-Build – Design-Builders, as part of their Design-Build contract agreement, will be required to provide the work scope described via **Exhibit C** of this Bulletin. This work scope outlines the requirements for the Arc Flash Hazard Analysis Study (and other requirements as indicated) and the associated Arc Flash Hazard Equipment Labeling to be provided.

END OF BULLETIN

**SCOPE OF SERVICES FOR ARC FLASH HAZARD ANALYSIS STUDY AND ARC FLASH HAZARD EQUIPMENT LABELS**

The following analysis/studies/reports are to be performed for all required electrical equipment as indicated below:

- A. The District shall be furnished a Short-Circuit Study in accordance with ANSI Standard C37 and IEEE Standard 141-1993.
  - a. The calculated short circuit currents levels shall be compared with the rated withstand ratings of equipment and interrupting ratings for overcurrent protective devices and a tabulation of all equipment devices shall state a status of either "pass" or "fail" based upon the above criteria.
  - b. A comprehensive report shall be prepared describing methodology and containing the results of the study in tabular form.
  - c. An engineering analysis of the results shall be provided along with recommendations for mitigation of any issues that are of concern.
- B. The District shall be furnished a Protective Device Coordination Study in accordance with IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems – IEEE Standard 242-2001 (Buff Book).
  - a. A comprehensive report shall be prepared describing methodology and containing device settings in tabular for and time-current graphs of selected representative portions of each system including a simplified one-line diagram of the portion of the system included in the graph.
  - b. The report shall evaluate whether devices are selectively coordinated, and new settings shall be proposed where necessary to improve coordination.
  - c. Where necessary to improve arc flash hazard conditions, new settings shall be proposed. Where selective coordination shall be compromised by these proposed settings, the report shall so state.
  - d. An engineering analysis of the results shall be provided along with recommendations for mitigation of any issues that are of concern.
- C. The District shall be furnished an Arc Flash Hazard Analysis Study per the requirements set forth in the current issue of NFPA 70E Standard for Electrical Safety in the Workplace. The Arc Flash Hazard Analysis shall be performed according to the IEEE Standard 1584 – 2002 and IEEE Standard 1584a – 2004 (Amendment 1).
  - a. The study shall include all buses in the system where personnel may be exposed to the hazard, including:
    - i. All system buses rated 240 V and higher and all system buses rated less than 240V where served by a transformer 112.5kVA and larger.
    - ii. System buses shall include, but not be limited to, switchgear, switchboards, transformer primary termination, transformer secondary termination, automatic transfer switches, manual transfer switches, motor starters, fused and non-fused disconnect switches, motor control centers, variable frequency drive input terminals, and sectionalizing switches.
    - iii. Buses rated less than 240 V which are served by transformers rated less than 112.5kVA shall be labeled in accordance with NFPA 70E, Table 130.7(C)(9).
  - b. A comprehensive report shall be prepared describing methodology and containing worst-case arc flash information for each bus in tabular form.
  - c. The report shall identify locations where the calculated arc flash hazard presents a particular danger to members of the public, including students and others who may be exposed.

- d. The report shall identify locations where physical changes to the system or added protective equipment can be applied to reduce the hazard.
  - e. An engineering analysis of the results shall be provided along with recommendations for mitigation of any issues that are of concern.
- D. The District shall be furnished a report on the observed condition of the electrical equipment and distribution systems based upon visual analysis and documentation and shall include:
- a. The age of the equipment
  - b. The type of equipment
  - c. An engineering evaluation of the typical life expectancy for the type of equipment
  - d. Observed physical condition, including presence of corrosion, cleanliness, documentation of maintenance
  - e. Presence of hazardous chemicals such as PCB oils.
- E. In the event new construction ties into as-built campus distribution or existing building distribution systems, determination of actual field conditions of the existing system shall be based upon the following methodology:
- a. Review of available background information
    - i. Consultant shall review the available drawings for each system including existing one-line diagrams, cable schedules, plan and elevation drawings, equipment submittals and available short-circuit studies, protective device coordination studies and arc flash hazard analysis studies.
    - ii. Information from the above sources shall be used as a basis for modeling and as a starting point for site assessment and data gathering activities.
  - b. Site assessment and data gathering
    - i. It is important that system impedances and protective device clearing times be modeled as accurately as possible to ensure that the results are representative of actual hazards, so Consultant is responsible for collecting actual system data.
    - ii. **It is imperative that the data gathering be accomplished in a safe manner**, and therefore it is desirable that equipment be de-energized while it is being examined if at all possible. This will require careful coordination with each campus Facility Director and electrical staff to schedule outages.
    - iii. All switching required to de-energize equipment and work required to open equipment for inspection by Consultant will be performed by a District approved electrician furnished by Consultant, or by a District electrician.
    - iv. If equipment must be examined hot, Consultant and electrician shall wear appropriate Personal Protective Equipment (PPE) based upon available information and the tables in NFPA 70E.
    - v. Examine all electrical equipment and installations in the field to verify data on existing one-line diagrams and to collect data needed to model the facilities.
    - vi. The following types of data must be collected:
      - 1. Nameplate data from transformers, reactors, generators, circuit breakers and fuses
      - 2. Relay and circuit breaker settings
      - 3. Fuse rating, type and speed
      - 4. Conductor sizes, types and approximate lengths
      - 5. Grounding configurations
      - 6. Utility source data including minimum and maximum fault values and X/R ratios
      - 7. System operating states
  - c. System modeling and analysis
    - i. Systems for each building and for each campus medium-voltage distribution system shall be modeled in SKM PowerTools for Windows™ version 6.5.1.7 using

system one-line diagrams, equipment manufacturer information, and data collected during site assessments.

- ii. Key assumptions shall be stated in the report, and shall include the following:
  1. Working distance for buses with a nominal voltage of 1000 volts or greater shall be assumed to be 36 inches.
  2. Working distance for buses with a nominal voltage of less than 1000 volts shall be assumed to be 18 inches.
  3. Clearing times for circuit breakers shall be based upon the equipment manufacturer's data under the assumption that these devices will operate according to specification. The report shall state that poor maintenance or age may adversely affect the performance and reliability of the protective devices.
  4. All faults shall be assumed to be three-phase faults. Single-phase equipment that meets the study criteria shall be analyzed as a three-phase equivalent.
  5. Maximum fault clearing time shall be capped at two seconds based upon IEEE 1584-2002 Annex B.1.2 and the assumption that an arc will self-extinguish or personnel will move outside of the flash protection boundary within two seconds time. Should egress be from the fault hazard zone be unusually restricted, a longer maximum fault clearing time may be assumed provided an engineering case is presented for the longer clearing time with the report.
- iii. Modes of operation
  1. Should alternate modes of operation exist, including operation of transfer switches and standby generators and alternate switching configurations within the medium-voltage distribution system each alternate configuration shall be studied and the worst-case results from among the modeled scenarios shall be reported and utilized for preparation of the arc flash labels.

F. Deliverables shall include the following:

- a. Bound printed copies and CDs or DVDs with electronic copies in Microsoft Word and PDF formats of each of the following reports:
  - i. Short-Circuit Analysis
  - ii. Coordination Study
  - iii. Arc Flash Study
- b. Full-sized one-line diagrams (electronic [PDF and CAD file formats] and hard copy) for each building or other electrical system on a standard LACCD border in AutoCAD format per the District's CAD and BIM standards.
- c. Incorporate Arc Flash Hazard Labels requirements/specifications into the project plans/specification to be furnished and installed by Contractor.
- d. PDF files for Arc Flash Hazard labels suitable for use by Installing Contractor to prepare actual labels shall be provided for each bus as follows:
  - i. Each label shall state the Arc Flash Hazard for the bus based upon the worst case scenario for that bus.
  - ii. Labels shall comply with NFPA and OSHA requirements for Arc Flash Hazard labels.
  - iii. Label to be vinyl tape material with adhesive, and be printed with indelible ink. The vinyl material should be 3 mil thick, and the material, adhesive, and ink should meet the latest version of ANSI Z535.4. The manufacturer should be DuraLabel or equal.

- iv. Labels shall identify the bus name, the equipment type, whether the bus is grounded or ungrounded, the working distance, the available 3-phase bolted fault current, the flash protection boundary, the incident energy at the working distance, the PPE level, the arc flash boundary, the limited approach boundary, the restricted approach boundary, the prohibited approach boundary, and the name and phone number of the Contractor.
- v. Consultant shall include requirements for printing and installation of Arc Flash Hazard Labels by the Installing Contractor. Installing Contractor shall be required to print the labels from the Consultant provided PDF files and install the labels on the enclosure for each bus in a location where they are visible to the personnel before examining, adjusting, servicing, or maintaining the equipment.
- vi. CD with an electronic copy of the SKM PowerTools for Windows™ data files for all systems studies, including all scenarios, to be provided to District and Installing Contractor.

**SCOPE OF SERVICES FOR ARC FLASH HAZARD EQUIPMENT LABELS**

- A. Arc Flash Hazard labels shall be printed from District provided PDF files (via Design Consultant) and installed on each bus as follows:
- a. Each label shall state the Arc Flash Hazard for the bus based upon the worst case scenario for that bus.
  - b. Labels shall comply with NFPA and OSHA requirements for Arc Flash Hazard labels
  - c. Label to be vinyl tape material with adhesive, and be printed with indelible ink. The vinyl material should be 3 mil thick, and the material, adhesive, and ink should meet the latest version of ANSI Z535.4. The manufacturer should be DuraLabel or equal.
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  - e. Contractor shall install the labels on the enclosure for each bus in a location where they are visible to the personnel before examining, adjusting, servicing, or maintaining the equipment.

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