

Arc Flash Analysis for New Installations

An arc flash analysis shall be provided for all new electrical equipment to ensure compliance with applicable industry standards for arc flash hazard identification and protection (i.e., National Fire Protection Association [NFPA 70E], Occupational and Health Administration [OSHA], National Electric Code [NEC], American National Standards Institute [ANSI], Public Employee Safety and Health [PESH], Institute of Electrical and Electronics Engineers [IEEE]). This analysis will determine the level of hazard and the proper rating of the personal protective equipment (PPE) necessary for personnel arc flash protection.

The Arc Flash Hazard Analysis shall, at a minimum, meet NFPA 70E Article 130.3 and Annex D; based on the formulas found in IEEE 1584 and satisfying the requirements of OSHA 29 CFR 1910.132(d).

The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted by a New York State registered Professional Electrical Engineer who is skilled in performing and interpreting the power system studies. The Registered Electrical Engineer shall have recent experience in performing power system studies.

Work shall include:

- A. Field Data Collection – The Engineer will collect, record all pertinent electrical component field data and create model drawings for the plant’s electric power distribution system. Typical field data may include but is not limited to transformers, switchgears, switchboards, motor control centers, panel boards, circuit breakers, protective relays, fuses, bus ducts, bus plugs, conductors, etc.
- B. Model and Perform Electric Power Systems Analysis – The Engineer will develop a software model of the system. This model will be used to perform the following studies:
 1. Short Circuit Current Study (SCCS) in accordance with ANSI Std. C37 and IEEE Std. 141-1993 (Red Book) for all applicable electrical components. This will also include an Equipment Evaluation Study to check the computed available fault current against existing equipment short circuit interrupting ratings.
 2. A Protective Device Coordination Study in accordance with IEEE Std. 242-2001 (Buff Book) for all applicable components to ensure that selection and arrangement of protective devices will limit the effects of an overcurrent situation to the smallest area.
 3. Arc flash hazard analysis to compute incident energy levels, proper ratings of PPE, NFPA 70E shock approach boundary distances at specified equipment locations, arc flash and shock protection boundaries, and warning label requirements. Incident energy and arc flash protection boundaries will be computed using IEEE Std. 1584, “*IEEE Guide for Performing Arc Flash Hazard Calculations*”. The Engineer will perform this study on all applicable exposure areas at the facility. The arc flash hazard analysis will also include identifying the available fault current at equipment buses as well as clearing time for applicable protective devices to determine proper PPE requirements. The PPE

determination will be based upon potential arc flash incident energy exposure levels and will determine:

- a. Proper PPE required for each applicable piece of electrical equipment.
 - b. Working distance for each applicable piece of electrical equipment.[‡]
 - c. Incident energy level for each applicable piece of equipment.
 - d. Flash protection boundary for each applicable piece of equipment.
4. The County has standardized on SKM Power Tools for Windows (SKM) as an electrical modeling software. Engineer shall use SKM to perform electrical power system analysis.
 5. The modeling method should be described in detail so that the minimum and maximum fault values are utilized in the model as two scenarios, with these results compared with the software, and arc flash labeling based on the highest value.
 6. The arc flash analysis should include a review of upstream overcurrent protective settings for all equipment with arc flash incident energy levels of 8.0 cal/cm² or higher to determine if the incident energy levels can be mitigated by adjusting the protective settings without compromising the reliability of the electrical distribution system.
 7. Infrequent operating situations (e.g., standby generator running and closed-transition switching) should be modeled and defined separately if the modeling scenario results in significantly higher arc flash values. In these situations, mitigation measures or modifications to the electrical safety plan to prevent live work when generator is operating, etc. should be identified.
- C. Produce Arc Flash Hazard Warning Labels – The Engineer shall furnish arc flash hazard warning label information for each applicable piece of equipment in accordance with ANSI Z535.4, NEC 110.16 and NFPA 70E 130.3, UL 969 guidelines. The label information will include:
1. Equipment description
 2. Voltage rating of equipment
 3. Flash Hazard Category
 4. Arc flash protection boundary (in.)
 5. Arc flash incident energy at the working distance (cal/cm²)
 6. Working distance (in.)
 7. Recommended protection including glove rating
 8. Limited, restricted and prohibited approach distances (in.)
 9. Bus and protective device identifier
 10. Bolted fault current
 11. Date of issue
 12. Service Provider contact information

Arc flash labels should be provided in the following manner and all labels should be based on recommended overcurrent device settings and cannot be installed until the overcurrent device settings have been set correctly.

1. For each 480 and 208 volt panel boards and disconnects, one label should be provided.
 2. For each motor control center, one label should be provided per section.
 3. For each low voltage switchboard, one label should be provided per section.
 4. For switchgear, one label should be provided per section.
 5. For medium voltage switches, one label should be provided per section.
 6. For buss tie breakers, one label should be provided based on dual feeds.
- D. Install Arc Flash Hazard Warning Labels – The Engineer should install the generated arc flash warning labels at the applicable equipment locations in accordance with NEC-2008 article 110.16.
- E. Arc flash labels should be installed at all electrical distribution panels regardless of incident energy level.
- F. Engineer shall provide updated one-line drawings (in AutoCAD) and one-line diagrams developed in the electrical model. SKM-exported model one-line diagrams shall not be utilized for the AutoCAD one-line drawings.
- G. As part of the deliverable, Engineer shall provide a physical condition assessment of the electrical equipment evaluated including photographs and condition observations (format to be provided by the County).
- H. The following deliverables shall be provided as part of the arc flash analysis:
1. Arc Flash report, consisting of the following:
 - General description of electrical approach boundaries
 - General description of arc Flash PPE applicable to the results of the study
 - Description of modeling scenarios utilized in the study to determine minimum and maximum fault conditions
 - One-line diagrams, as developed in the modeling software
 - Separate study results for generator power (if applicable)
 - Utility data (if applicable to the study)
 - Fault data at all major electrical panels
 - Summary of arc flash results
 - Identification of required arc flash label locations (Note: not all panels require labels, and some panels require more than one label).
 - Summary of mitigation review
 - Input data report
 2. Field data schedules (summary data tables of field data utilized in the model)

3. CD, DVD, or USB flash drive containing all electronic files associated with the electrical model. Include the following:
 - All files created by the modeling software which are associated with the electrical model.
 - All spreadsheets of electrical modeling results which are exported from the electrical model to EXCEL file format.
 - PDF of the full arc flash report, including narrative, attachments and appendices.
 - Field photos (for reference only, Note: The intent here is to share photo information which may have been gathered in the field.)

[‡] Working distances are defined by IEEE 1584, Table 3 based upon the operating voltage of the equipment up to 15 kV.