



# RESEARCH FOUNDATION

## RESEARCH FOR THE NFPA MISSION

### PROJECT SUMMARY

## Electrical Circuit Data Collection

Last Updated: 2 May 2019

#### **Background:**

The service, feeder and branch circuit load design requirements in NFPA 70, *National Electrical Code*® (NEC®) may need to be updated based on the increasing pace of technological innovation along the entire span of the electrical power chain.

Factors such as today's Energy Codes are driving down the electrical load presented by end use equipment and thus load growth assumptions that justify "spare capacity" are being re-examined. In addition, larger than necessary transformers that supply power to service, feeder and branch circuits may expose unnecessary flash hazard to electricians working on live equipment.

Recently a Phase 1 research study reviewed the literature on this topic and developed a data collection plan (see "[Evaluation of Electrical Feeder and Branch Circuit Loading: Phase 1](#)"), with an emphasis on general commercial (office) occupancies. This project addresses this proposed data collection plan.

#### **Project Goal and Scope:**

The goal of this project is to implement a data collection plan to provide sufficient receptacle demand and load data for a variety of occupancies, to provide a technical basis for considering revisions to the service, feeder and branch circuit design requirements in the National Electrical Code®. The project will seek to provide the necessary data and analytics for the targeted spaces and occupancies addressed by this project, and also set a clear approach for future efforts addressing other occupancies. The scope of this project seeks to address the following:

- Demand and loading of electrical receptacles, including all peak demand (i.e., worst case) scenarios.
- Focus on circuits with 120 volts and 15 or 20 amps.
- A baseline focus of comparable targeted spaces including (1) breakrooms, (2) General office areas, (3) conference rooms, and (4) cubicles, within occupancies for (A) business, (B) educational, and (C) healthcare.
- Focus on additional comparable targeted spaces along with unique targeted spaces within the occupancies for (A) business, (B) educational, and (C) healthcare, as the resources of the project allow and with direction from the project Panel.
- Geographic diversity of participating occupancies, reflecting the diversity of key drivers of this issue (e.g., energy codes in different jurisdictions).

#### **Affected NFPA Documents:**

NFPA 70, *National Electrical Code*®, Articles 210 through 230.

### **Schedule and Implementation:**

This is an approximate eight-month effort after project initiation. This project is financially sponsored by generous support from the American Society for Healthcare Engineering (ASHE) and the National Fire Protection Association (NFPA). Project Data Providers will be coordinated with at least the following: ASHE, NFPA, and APPA (i.e., facility administrators for universities and colleges). This research project is led by the Fire Protection Research Foundation and will be conducted in accordance with the “[Research Foundation Policies for the Conduct of Research Projects](#)”.

### **Project Participants:**

This project involves the following participants, in accordance with the [Research Foundation Policies for the Conduct of Research Projects](#) (a.k.a., Policies):

- **Project Contractor:** The Project Contractor is the organization and individuals responsible for the overall technical oversight of the project, and is responsible for the development and implementation of the data collection plan, the analysis of the project data, and the generation of the project final report and other project deliverables.
- **Project Data Providers:** This project also involves Project Data Providers, who will be contributing the collection of electrical data from their facilities. To the extent possible the Project Data Providers will provide the support of their facilities, including their electricians to enable the installation and removal of data recording devices. Where possible, the Project Data Providers will provide the data measurement equipment.
- **Project Technical Panel (a.k.a., Panel):** The Panel provides overall guidance to the Project Contractor in accordance with Foundation Policies. The Panel is administratively handled by the Research Foundation.

### **Project Tasks:**

This project is based on the establishment and implementation of a Data Management Plan by the Project Contractor. It is focused on the collection of data from the Project Data Providers, with efforts to be taken for the proper handling of the data to sufficiently address concerns such as privacy, confidentiality, competitiveness, and security. With on-going guidance from a Project Technical Panel (in accordance with Foundation Policies), this project involves the following tasks:

- 1) **Task 1: Summarize Applicable Background Information.** Identify and compile the necessary information to support the implementation of the data management plan, analysis of data, and project final report. This includes clarification of the need for this project, overview of project characteristics and challenges, summary of applicable literature, review of previous applicable data collections, and other information to be included in the project’s final report.
- 2) **Task 2: Establish the Data Management Plan.** Generate a detailed data management plan that clarifies the approach for how the data for this project will be captured, handled, stored, and accessed, in a manner that assures the proper handling of data with confidential or proprietary implications.
  - a. **Confirm Baseline Targeted Spaces.** Address the baseline focus of comparable targeted spaces including (1) breakrooms, (2) general office areas, (3) conference rooms, and (4) cubicles, within occupancies for (A) business, (B) educational, and (C) healthcare. Consider focus on additional comparable targeted spaces along with unique targeted spaces, as the resources of the project allow and with direction from the project Panel.

Each occupancy (i.e., A, B, & C) will provide 3 of each comparable targeted spaces, for a total of 12 from each occupancy for an overall total of 36 space locations addressed as the baseline for this project. See Table 1: Summary of Targeted Spaces for Baseline. Consider targeted spaces with maximum diversity of key factors such as geographic region, occupancy type, and electrical usage.

Table 1: Summary of Targeted Spaces for Baseline

	<b>(A) Business Occupancy</b>	<b>(B) Educational Occupancy</b>	<b>(C) Healthcare Occupancy</b>
<b>Comparable Spaces</b>	(1) Breakrooms	(1) Breakrooms	(1) Breakrooms
	(2) General Office Areas	(2) General Office Areas	(2) General Office Areas
	(3) Conference Rooms	(3) Conference Rooms	(3) Conference Rooms
	(4) Cubicles	(4) Cubicles	(4) Cubicles
<b>Unique Spaces</b>	TBD (per available resources)	TBD (per available resources)	TBD (per available resources)

- b. Identify Project Participants and Roles. Identify all project participants with the assistance of project sponsors and the project panel, with a particular focus of Project Data Providers. Confirm the scope, tasks, costs and other applicable details for the Project Data Providers.
- c. Clarify Details of Data Collection Implementation. Provide clear detail of the specific steps for the Data Collection Plan. This will include, though not be limited to the following, with adjustments based on Panel guidance:
  - i. Coordinate initial site visit. For each participating targeted space, coordinate the initial site visit.
  - ii. Collect & document specific site data. Utilize the initial Phase 1 effort as baseline information & as a starting point. Examples of details that should be considered include, but are not limited to:
    - description of space;
    - existing conditions;
    - number and location of receptacle outlets, and number of outlets on each circuit (e.g., on floor plan);
    - area of impacted areas (e.g., in square feet);
    - equipment plugged into receptacles;
    - number of occupants;
    - use schedule of space;
    - electrical panels and schedules highlighting which circuits have been measured; and
    - other information deemed to be important for project deliverables.
  - iii. Coordinate with facility electricians to identify applicable circuits.
  - iv. Install measurement equipment. Working with the facility electricians, use CT technology (i.e., current transformers or current transducers) or equivalent to enable the recording of usage for each branch circuit. Assure the applicable monitoring devices allow for the ability to monitor remotely to assure it remains active during the tests, and captures streaming data in at least 15 minute intervals.
  - v. Confirm measurement recording. Confirm that all applicable measurement equipment is properly recording the data needed from the targeted spaces. Confirm contact information between the contractor and with all facilities participating in the test.
  - vi. Confirm test time frame. Confirm with the participating facility that the test will proceed to collect data for at least 1 month. Consider extending or shifting this time frame if necessary to test during peak demand periods (e.g., school in session at an educational occupancy).
  - vii. Collect and document specific site data. Using the information collected on the initial site visit, clarify all data that has changed or otherwise support the project deliverables.

- viii. Coordinate site close-out. Once the applicable data has been collected over the assigned time frame, and the test has been completed at the facility, coordinate with the applicable representatives of the Project Data Providers to close-out their participation. Working with the facility electricians, remove and/or clarify the final disposition of the recording equipment used to collect data for each space.
  - d. Generate Detailed Budget. For all the Task 2 activities and in support of the Data Management Plan, generate a detailed budget of costs for the Project Contractor and the Project Data Providers. The primary contributions being sought by the Project Data Providers will be the use their facilities and the support of their facility electricians for the installation and removal of electrical monitoring equipment.
  - e. Confirm Implementation Schedule. Review the time frame with all project participants.
- 3) **Task 3: Confirm Data Management Plan and Primary Data Elements**. Identify, clarify and summarize the Data Management Plan and the primary data elements that will be captured by this project (see Task 2(b)(ii)). Meet by conference call with the Project Technical Panel to provide an interim report on Tasks 1, 2 & 3, to clarify all aspects of the Data Management Plan and primary data elements. Focus on identifying the primary data elements that will have the greatest positive influence on the project deliverables.
- 4) **Task 4: Implement Data Management Plan and Data Collection**. Implement the Data Management Plan and data collection with the Project Data-Providers, for the time frame established in the Data Management Plan. This should also be coordinated with the data elements reviewed and confirmed in Task 3, and should be packaged in the necessary formats that will facilitate its analysis in support of project deliverables.
- 5) **Task 5: Analyze Data Collections**. Analyze project data collected during the project and finalize at the conclusion of all data collection. This should include a summary and analysis of all applicable data in support of project deliverables. Data should reflect peak demands and time frames, based on each branch circuit, number of receptacles per circuit, number of receptacles/ft<sup>2</sup>, and other units deemed to be of greatest value. Include analysis with variables that can have an influence on electrical demand, such as time of day, ambient temperature, and weather conditions. Outline a detailed plan for collecting additional data for other occupancies through future projects, and address in this plan any other remaining gaps relating to service, feeder and branch circuit demand and loading. Meet by conference call with the Project Technical Panel to provide an interim report on Task 5 to clarify and confirm the approaches used for data analysis.
- 6) **Task 6: Reporting and Dissemination**: Generate a consolidated final report documenting the entire effort. Review and obtain comments on the draft final report from the Project Technical Panel. Finalize the project documentation into a report that will be posted on the Foundation website and made openly available. Disseminate the report with circulation to the applicable NFPA Code Making Panels, Technical Committees and related stakeholders.

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