



# RESEARCH FOUNDATION

## RESEARCH FOR THE NFPA MISSION

### Electrical Circuit Data Collection

### Meeting Minutes

CONFERENCE CALL

TUESDAY, 30 APRIL 2019; 1:00 PM – 2:00 PM ET

1) Call to Order and Attendees. The meeting was called to order at 1:00 pm ET by Casey Grant of the Fire Protection Research Foundation. The following were in attendance:

Mike Anthony, University of Michigan (MI)  
Larry Ayer, Biz Com Electric & IEC (OH)  
Tom Domitrovich, Eaton Corporation (MO)  
Lou Galante, APPA and University of Iowa (IA)  
Casey Grant, FPRF (MA)  
Alan Manche, Schneider Electric (KY)  
Roger McDaniel, Georgia Power Company (GA)  
Robert Osborne, UL LLC (NC)  
Troy Savage, Mazzetti (VA)  
Walt Vernon, Mazzetti, (CA)  
Billie Zidek, APPA (VA)

For reference, the updated Panel Roster is included herein as Attachment A. Also attached is the Project Summary for this effort, and this is a public document that can be shared with others. The meeting agenda was indicated to kick-off this project with the project contractor, and review the work plan including: tasks, scope, timeline, deliverables, and other applicable details.

2) Introduction / Preliminaries. Casey Grant provided a re-cap of the Foundation Policies and Procedures as it relates to this meeting:

- In accordance with the Policies, the role of the Panel is advisory in nature and intended to provide guidance back to the contractor, who is ultimately the report author.
- The Panel will oversee the technical conduct of the project including progress reviews and review of reports and other deliverables.
- All reports are authored by the contractor.

- All project reports shall be the original work of the project contractor and all collaborators unless otherwise identified. Plagiarism is grounds to terminate a contract.
- Project results and interim reports should not be issued prior to the completion of the final report without Foundation approval. The Project Summary is intended to be a publically available document (i.e., Attachment B) and this can be openly shared.
- Once fully reviewed and completed, all Foundation reports are made publicly available.

3) Review and Discussion of the Project. Troy Savage led a general discussion of the project, using the slides contained in Attachment C, with additional support from Walt Vernon. The group engaged in a discussion and the following comments, questions and observations were mentioned:

- The Project Summary for this project will be available after this call, and this will be our publically available summary to tell others about this effort.
- It was questioned if we will have other spaces to target? The project will attempt to address all the targeted spaces as indicated in the RFP, and additional spaces if within the resources available for the project.
- Clarify the anticipated metering equipment that will be used by the project?
  - Will the contractor provide metering equipment?
  - It is hoped that the data providers will provide per an agreed-upon performance spec, as this will optimize the available project resources. Otherwise the contractor will provide metering equipment.
  - As an example of the metering equipment being considered, we are looking at meters from Panoramic and/or HOBO, which are at a cost of about \$200/each.
  - However, the meter specs will be important, and we will need to be clear on the data we are trying to collect. For example, ideally this will be at a one minute interval, or similar, and the recording time period needs to be clear.
  - The meters and recording devices for this project should be relatively straight-forward. We do not need high-end sophisticated meters.
  - Project Task 2 will clarify these details.
- Clarify the data providers?
  - This is generally indicated in the RFP, and these still need to be identified.
  - Data providers that will be able to provide their own recording devices will be favored.
  - Having geographic diversity of data providers is a plus. It's helpful that the contractor has multiple offices located throughout the United States, and locations near their offices will also be considered preferred sites.
  - Ultimately we are looking for (at least) nine sites, overall with 36 recorders, perhaps with some sequentially and with some sites in parallel. Ultimately we hope to optimize the number of sites.
  - The number of panels that will ultimately be used also still needs to be clarified. This and other key details will be reviewed as part of Task 2 and 3, to establish and implement the Data Management Plan.

- For more sophisticated data providers, the contractor will consider providing a specific protocol that could be implemented unilaterally without site visits, to further optimize the data collection effort.
- There is not an awareness of any of the data providers already having data collection equipment in place.
- The contractor will consider working with other partners that are also obtaining electrical circuit data, to further optimize the overall effort. For example, this might boost the data collected by obtaining both circuit level and panel level data.
- Consider an alpha test first before full implementation.
  - It would be ideal if we could first consider an alpha test using a limited number of panels first at a limited number of sites, to prove the approach is delivering the ideal data. This could be done prior to full implementation of the plan.
  - It was generally agreed that this approach has merit, and this will be considered by the contractor in the formulation of Task 2.
  - It was noted this might push the schedule out, and this will be addressed by the contractor in Task 2. The Panel indicated there are no external deadlines influencing this effort such that a delay of a couple of months is not a problem. However, in considering this approach we will want to make sure we stay within the resources of the project.
  - It was agreed that having an alpha tier 1 approach will be valuable, if possible.
- From the Panel's standpoint, we are looking for a desired endpoint. We are looking at providing the necessary quantity and quality of data that can be used, in the codes and standards process by others. For example, in previous revision cycles of the NEC the Correlating Committee questioned existing data that was not fully consistent, and they would like to see research results that address the discrepancies.
- From the standpoint of targeted spaces, universities and colleges have a lot to offer in addition to educational type occupancies. For example, a typical college has virtually every occupancy on a typical campus. We want to make sure we cover the baseline, and possibly address certain special areas, like classrooms, laboratories, shops, etc. These will need to be balanced with resources of the project.
- The next steps are the re-grouping at task 3 for review of the Data Management Plan, which will need to be scheduled in about 3 months. However, it would be very helpful to re-group before then, and thus plan for a preliminary interim update in 1 and ½ months. It was agreed to set-up the next conference call for 60 minutes for on 26 June 2019 at 1:00 pm ET.

4) Next Steps and Wrap-Up. In closing, Troy Savage thanked everyone involved. Casey Grant clarified the next steps for the Panel. We will consider another Panel conference call in about 1 and ½ months (late June 2019) for a preliminary review of efforts, which will assist with the review of Tasks 1, 2 and 3 in approximately 3 months. It was agreed that we should have a 60 minute conference call on 26 June 2019 at 1 pm Eastern time zone. Casey Grant will coordinate with Troy Savage to use the Mazzetti web platform, and Casey will forward the group an outlook invite to get this on everyone's schedule.

5) Adjournment. Panel members were thanked for their participation, and the meeting adjourned at 2:10 pm.

(Meeting Summary by C. Grant, 8 May 2019)

<b><u>Attachments</u></b>		
Attachment	Description	No. of Pages
A	Updated Project Roster	1
B	Project Summary	4
C	Slides for Project Review	8



# RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

## Electrical Circuit Data Collection

### PROJECT CONTACTS

Last Updated: 2 May 2019

#### Project Technical Panel

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#### Sponsor and Research Team Contacts

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# 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.

###



Fire Protection Research Foundation  
**Electrical Circuit Data  
Collection Research  
Project**

Project Overview  
April 9, 2019

Project Financial Support: American Society of Heating, Refrigeration and Air Conditioning (ASHRAE) and the National Fire Protection Association (NFPA)

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## Project Goals

- Implement data collection plan to provide sufficient receptacle demand and load data to provide a technical basis for considering revisions to the service, feeder and branch circuit design requirements in the NEC.
- Provide sufficient data for targeted spaces and occupancies.
- Set clear approach for future efforts addressing other occupancies.

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## Project Scope

- 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.
- Occupancies: (A) business, (B) educational, and (C) healthcare.
- A baseline focus of comparable targeted spaces including (1) breakrooms, (2) general office areas, (3) conference rooms, and (4) cubicles, within these occupancies.
- Focus on additional comparable targeted spaces along with unique targeted spaces within the occupancies as the resources of the project allow and with direction from the Project Panel.
- Provide Geographic diversity within each occupancy type.

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## Targeted Space Summary

	(A) Business Occupancy	(B) Educational Occupancy	(C) Healthcare Occupancy
Comparable Spaces	(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
Unique Spaces	TBD	TBD	TBD

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## Project Roles

- Project Contractor: Mazzetti
  - Overall technical oversight
  - Development and implementation of data collection plan, analysis of data and generation of project final report
- Project Technical Panel
  - Provide overall guidance to Project Contractor
- Project Data Providers: TBD
  - Contribute electrical data from facilities.
  - Provide support of facility (including electricians for installation and removal of measurement equipment, and, where possible, provision of equipment.)

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## Project Tasks

- Task 1: Summarize Background Information (May – June, 2019)
- Task 2: Establish Data Management Plan (May – June, 2019)
  - A. Confirm Baseline Targeted Spaces
    - 3 occupancy types x 3 sites per occupancy type x 4 targeted spaces per site = 36 space locations
  - B. Identify Project Participants and Roles
  - C. Clarify Details of Data Collection Implementation
  - D. Generate Detailed Budget
  - E. Confirm Implementation Schedule
- Task 3: Confirm Data Management Plan and Primary Data Elements\*\* (by end of July, 2019)
- Task 4: Implement Data Management Plan and Data Collection (start by end of Aug., 2019)
- Task 5: Analyze Data Collections\*\* (by end of Oct., 2019)
- Task 6: Report and Dissemination (by end of Dec., 2019)

\*\* Interim update to be provided to Project Technical Panel

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## Data Collection Implementation Details


- Coordinate initial site visit
- Collect and document specific site data
  - Plans
- Identify applicable circuits
- Install measurement equipment
- Confirm measurement recording
- Test for at least 1 month
- Confirm site data
- Coordinate site closeout (remove recording equipment as required)

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## Mazzetti and Electric Circuit Data Collection

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**MAZZETTI**

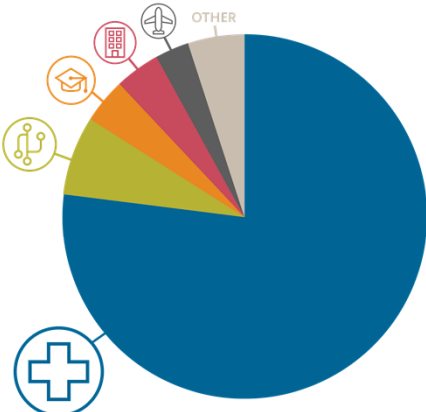
**200+ PEOPLE**

AVG. TENURE: **7 YRS**

YEARS IN OPERATION: **57**

**100% EMPLOYEE OWNED  
BENEFIT CORPORATION**

**WHERE WE WORK:**



**11 LOCATIONS**

CITY, ST	Count
SAN FRANCISCO, CA	48
NASHVILLE, TN	33
SEATTLE, WA	20
PORTLAND, OR	30
ST. LOUIS, MO	18
ATLANTA, GA	18
DENVER, CO	15
IRVINE, CA	8
ARLINGTON, TX	6
SACRAMENTO, CA	7
BANGALORE, INDIA	5

**101% COMMITMENT TO:** **58** LICENSED PROFESSIONAL ENGINEERS

MAKING THE WORLD A BETTER PLACE

9

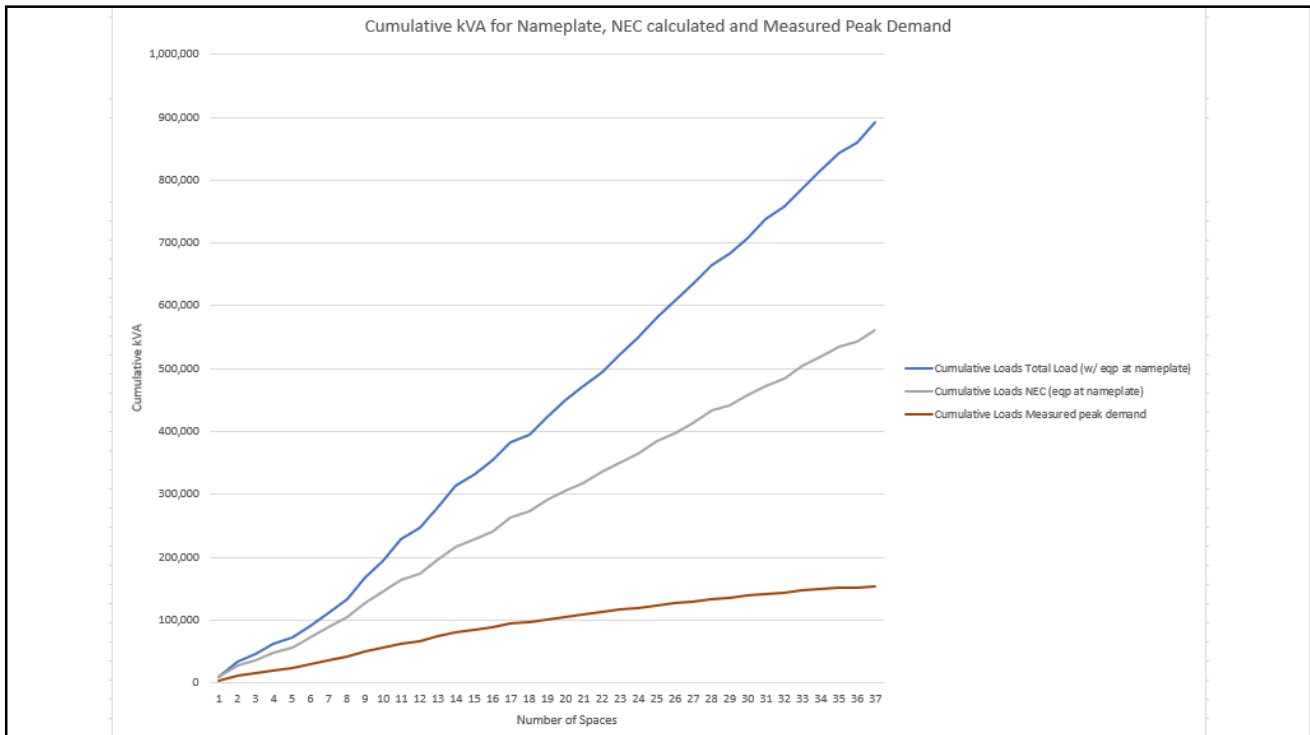


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# Previous Related Study

Row #	Connected Load (VA)					Measured Peak VA	NEC DEMAND LOAD	Safety Factor Above Measured Demand	Cumulative Loads				
	# Recepts	Recep load	# CORD CONN EQP	Cord Con Load (nameplate)	Total Conn. Load, equip at nameplate		CORD CONN AT nameplate	NEC (w/ eqp at nameplate)	Measured peak demand	Recep Load	Cord Conn Load (nameplate)	Total Load (w/ eqp at nameplate)	NEC (w/ eqp at nameplate)
22	22	3,960	8	4,681	8,641	3,290	8,641	163%	3,290	3,960	4,681	8,641	8,641
37	113	20,340	5	5,080	25,420	7,550	20,250	168%	10,840	24,300	9,761	34,061	26,911
34	28	5,040	7	5,843	10,883	3,790	10,883	187%	14,630	29,340	15,604	44,944	35,274
26	47	8,460	7	8,302	16,762	5,760	16,762	191%	20,390	37,800	23,906	61,706	47,806
35	28	5,040	7	5,663	10,703	3,670	10,703	192%	24,060	42,840	29,569	72,409	55,989
16	3	540	23	16,712	17,252	5,780	17,252	198%	29,840	43,380	46,281	89,661	72,971
25	50	9,000	13	11,302	20,302	6,420	20,302	216%	36,260	52,380	57,583	109,963	88,773
21	92	16,560	9	7,602	24,162	6,140	20,882	240%	42,400	68,940	65,185	134,125	104,655
8	118	21,240	11	11,326	32,566	7,680	26,946	251%	50,080	90,180	76,511	166,691	126,601
9	107	19,260	14	8,976	28,236	6,620	23,606	257%	56,700	109,440	85,487	194,927	145,207
1	164	29,520	4	3,400	32,920	6,240	23,160	271%	62,940	138,960	88,887	227,847	163,367
20	102	18,360	1	360	18,720	3,850	14,540	278%	66,790	157,320	89,247	246,567	172,907
5	111	19,980	17	12,914	32,894	7,230	27,904	286%	74,020	177,300	102,161	279,461	195,811
7	147	26,460	10	7,007	33,467	5,950	25,237	324%	79,970	203,760	109,168	312,928	216,048
30	76	13,680	7	5,584	19,264	4,000	17,424	336%	83,970	217,440	114,752	332,192	228,472
15	110	19,800	6	2,310	22,110	3,880	17,210	344%	87,850	237,240	117,062	354,302	240,682
31	66	11,880	13	15,805	27,685	5,920	26,745	352%	93,770	249,120	132,867	381,987	262,427
10	28	5,040	21	8,716	13,756	3,010	13,756	357%	96,780	254,160	141,583	395,743	273,663
32	113	20,340	7	7,837	28,177	4,750	23,007	384%	101,530	274,500	149,420	423,920	291,670
24	119	21,420	5	3,620	25,040	3,710	19,330	421%	105,240	295,920	153,040	448,960	306,000
14	128	23,040	0	0	23,040	3,150	16,520	424%	108,390	318,960	153,040	472,000	317,520
27	57	10,260	18	12,767	23,027	4,350	22,897	426%	112,740	329,220	165,807	495,027	335,417
17	138	24,840	4	3,333	28,173	3,650	20,753	469%	116,390	354,060	169,140	523,200	351,170
12	147	26,460	0	0	26,460	3,170	18,230	475%	119,560	380,520	169,140	549,660	364,400


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Aim

- Provide technical basis for considering revisions to the service, feeder and branch circuit design requirements in the National Electrical Code.
- Affected NFPA Documents: NFPA70 (NEC), Articles 210 through 230.

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## Discussion

- Are there other spaces to target within occupancies (as project resources allow)?
- Any concerns with the (RFP) proposed approach?
- Other concerns?

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**Troy Savage**  
*Project Manager*

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