Vol XXI, Issue 3

PLAINS TALK

A Publication of West Plains Engineering, Inc.

June/July 2019

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Electrical Specialties Takeover Edition

MECHANICAL ELECTRICAL PLUMBING POWER

AN ENGINEERING SOLUTION CENTER

IN THIS EDITION...

This edition, we handed over the keys to Plains Talk to Electrical Specialties Division Manager Todd Weidner, P.E. to discuss the unique and critical role his division plays for clients.

When I tell people I manage the "Electrical Specialties" division at West Plains Engineering, it always takes a bit of explaining. The fact is, my division covers a wide range of very specific electrical studies and assessments used to improve distribution systems. Some of these, like arc flash, are fairly familiar. But others, like thermography and power quality, aren't always on their radar.

In this edition of Plains Talk, I wanted to not only explain the various studies out there, but show some real life examples of how we've put them to use. My goal is for clients to understand the code ramifications, preventative maintenance and cost savings these assessments provide. What's more, many of them are critical to simply keeping people safe.

If you want to learn more, I'm happy to arrange a lunch-n-learn or other training on any of these topics.

Todd

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Team Spotlight

TODD WEIDNER

Title: Electrical Specialties Division Manager
Years with WPE: 18 Years
Home Team: Todd and his wife Linda have four children: Jordan (20), Ben (19), Holly (16) and Sam (14)

When Todd Weidner joined West Plains Engineering as an Electrical Engineer in 2000, he had already been performing the studies required by the National Electric Council (NEC) for some years. But being an engineer, he wanted to know more about the "how" and "why" behind them, and if there were other tools he could use to help his clients.

In 2015, he set out on his own path and created the WPE Electrical Specialties Division. Now, his work focuses mainly on educating clients on the importance of electrical studies, and becoming a trusted advisor performing them across the Upper Midwest. His favorite? Thermography. Not only are the images pretty cool to look at *(check out Page 8)*, but Todd finds it's also the most versatile and finds new applications for its use almost daily.

Since starting the division, Todd also realized there's another tool essential to his clients' electrical safety – training. In 2018, he became a Certified Electrical Safety Compliance Professional and now offers the complete electrical safety package – from system evaluation to reporting, mitigation strategies and most importantly, on-site employee safety training.

A native of Iowa, Todd and his family now live in Sioux Falls, where he enjoys hunting, fishing, writing and working out with his kids.

WPE Continues "Design in the Hills" Support

For the fourth straight year, West Plains sponsored the bus tour of the annual "Design in the Hills" conference put on by South Dakota AIA. This year's event focused on innovation in design, and gave attendees behind the scenes access to the new Black Hills Energy Headquarters, Regional Health Advanced Orthopedic & Sports Medicine Hospital and the green roof at the Rapid City Regional Airport.

Welcome New Team Members

Caden Goetschius
CAD Technician
Sioux Falls

Messo Hekima
Electrical Engineering Intern
Rapid City - Power Division

PROJECT PROFILE

ARC FLASH ANALYSIS

City of Sioux City
Sioux City, IA

MODEL FOR MUNICIPAL PREPAREDNESS

In 2017, West Plains Engineering was hired by the City of Sioux City in Iowa to conduct a series of arc flash studies on 120 city-owned facilities. The facilities ranged in size from single panels to multiple services and hundreds of panels. Some were primary metered with medium voltage distribution as well.

The more notable sites included the Tyson Event Center, Waste Water Treatment Plant, Explorer's Baseball Complex, Convention Center, Art Museum, fire stations, golf courses, airport facilities, police training complex, Long Line Recreation Center and all parks and pools.

All sites have now been modeled and labels installed. **In total, more than 1,000 labels were installed.**

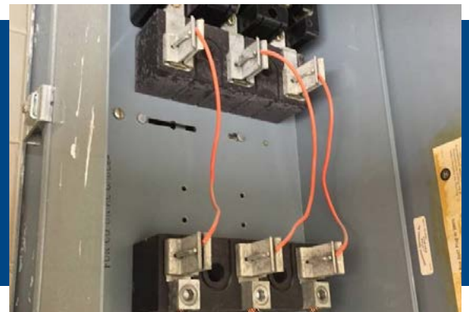
Some of the challenges in a project this size were getting utility information for this many sites, getting into certain facilities, scheduling with 40 different owners, scheduling for data collection and again for label installation, few 1-lines were available and overall project coordination.

The utility didn't have all sites modeled yet, so the project was extended to allow the utility to catch up. There were even instances where the utility had to do field work to verify existing conditions. There was the usual challenge of most buildings having no 1-lines, but now, Sioux City has complete and accurate 1-line diagrams for all facilities, which is an extremely valuable benefit for arc flash studies in the future.

Simply put, an **Arc Flash** is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur.

THE WORST CASE...

We've seen some concerning systems when performing these studies, but the most shocking (pardon the pun) was during an arc flash study. In this instance, the #10 wire we found in 2 bus duct disconnect in lieu of fuses to serve transformers. The wire is no longer made, so we knew it happened during construction of the building. It's a wonder (and a miracle) there wasn't a serious fire over the 50 years this existed.

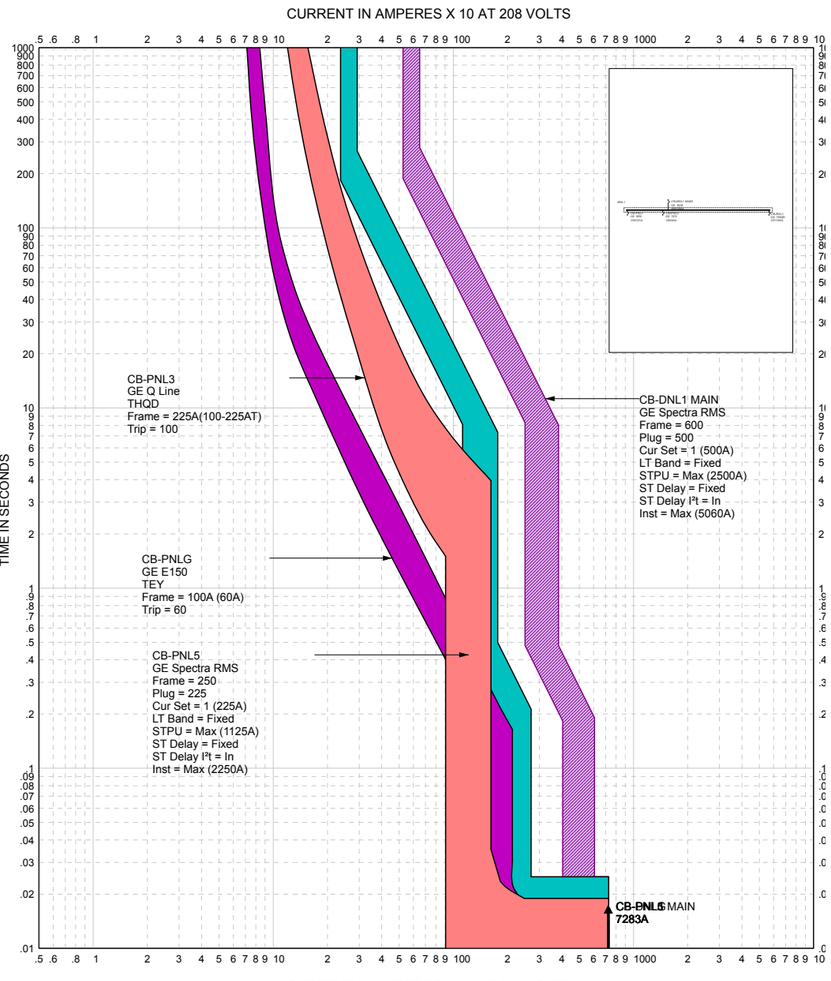


COORDINATION

PROJECT PROFILE

SELECTIVE COORDINATION STUDY

Avera BE Merrill Pioneer Hospital
Rock Rapids, IA



The term **Selective Coordination** refers to the selection and setting of protective devices (circuit breakers and fuses) in an electric power system in such a manner as to cause the smallest possible portion of the system to be de-energized due to an abnormal condition.

LIFE SAVING SELECTIVE COORDINATION

While important in any commercial setting, selective coordination in health care is absolutely critical. After all, something as mundane as the coffee pot shorting out in the breakroom could easily take out life safety electricity in the operating room.

Coordination ensures the proper breakers/ fuses trip in these situations to minimize impact elsewhere.

In 2017, we worked with Avera's new BE Merrill Pioneer Hospital in Rock Rapids, IA to assure proper coordination throughout the facility per the National Electrical Code (NEC).

This project required more than 30 Time Current Curves (TCC) be generated and studied. Simply put, our team made sure nothing in those curves overlapped – and the facility could be confident their electrical system was safely coordinated.

Load Flow is essentially an assessment of balance. This power analysis ensures that the electrical distribution system is not overloaded in any one area, but is instead optimally balanced across the operation.

PROJECT PROFILE

LOAD FLOW STUDY
Prairie Aquatech
Volga, SD

OPERATIONAL OVERLOAD

Prairie Aquatech (PAT) is a forward-thinking aquaculture protein production company located in rural South Dakota. At it's core, the company produces food for bait fish farmers (aquafeed manufacturers). Founded by two South Dakota State University graduates, PAT developed a technology to extract protein from soybeans, which can then be sold as feed. This process takes place in their manufacturing facility in Volga, SD, where our team performed a load flow study in 2019.

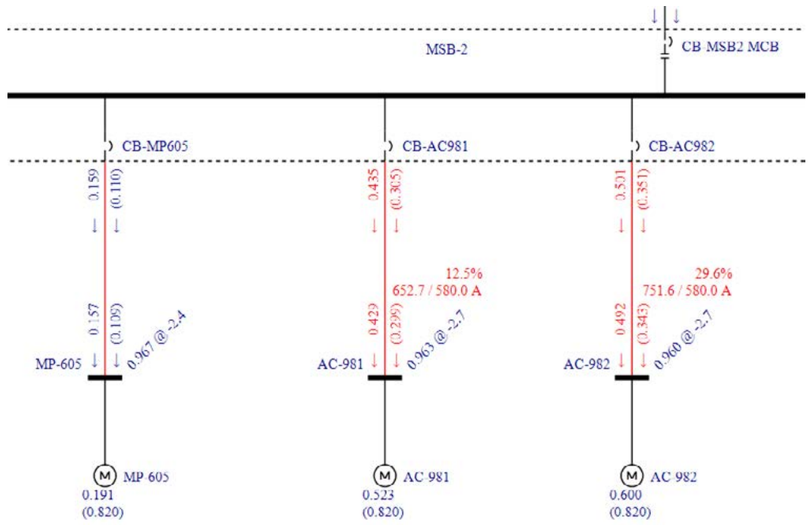
The facility consists of three 4000 Amp services and hundreds of motors. With that many motors starting and stopping, a load flow study was imperative. The utility would only provide up to a 2500KVA transformer for each service. Total connected load is more than the switchboard capacities. The study provides real running loads, along with verification of overloads based on production sequences. Scenarios can be run to find the best load diversity over the three services and processes.

LOAD FLOW

Line Overload Report

Overload Threshold = 10.00 %

Line				Load			
From Bus Name	To Bus Name	Branch Name	Rated Amps	Load Amps	Loaded%	OverLoaded%	Comment
H2	T2-P	C-T2	100.0	0.0	0.0%	-100.0%	
H3	T3-P	C-T3	100.0	0.0	0.0%	-100.0%	
H4	T4-P	C-T4	85.0	0.0	0.0%	-100.0%	
MCC2	A-750	C-A750	30.0	7.5	25.1%	-74.9%	
MCC2	A-220	C-A220	30.0	7.5	25.0%	-75.0%	
MCC2	A-230	C-A230	30.0	7.5	25.0%	-75.0%	
MCC2	P-271	C-P271	95.0	33.5	35.3%	-64.7%	
MCC2	P-990	C-P990	30.0	2.1	6.9%	-93.1%	
MCC2	A-240	C-A240	30.0	7.5	25.0%	-75.0%	
MCC2	P-210	C-P210	40.0	10.9	27.2%	-72.8%	
MCC2	P-250	C-P250	30.0	7.5	25.1%	-74.9%	
MCC2	RV-112	C-RV112	30.0	4.7	15.8%	-84.2%	
MCC2	P-750	C-P750	55.0	20.8	37.8%	-62.2%	



PROJECT PROFILE

POWER FACTOR CORRECTION STUDY

Cloverleaf Cold Storage
Monmouth Manufacturing Plant
Crest Hill, IL

POWER FACTOR CORRECTION

GET THE POWER YOU PAY FOR

Poor power factor is not only inefficient, it's expensive. When apparent power (kVA) is greater than real power (kW), the utility must supply the excess reactive current *plus* the working current. If this occurs, obviously, the end user will be charged for it. Ultimately, low power factor means not utilizing the electrical power being paid for.

Power factor can be improved by adding power factor correction capacitors to the facility electrical distribution system to:

- Reduce electrical bills – usually a relatively short payback period
- Increase (release) system capacity
- Reduce power losses
- Improve voltage

In 2015, West Plains Engineering worked with longtime partner Cloverleaf Cold Storage on a power factor correction analysis at the company's Monmouth facility in Illinois. This 250,000 square foot refrigerated storage facility has four 700HP & 3-500HP compressors along with 750HP of additional motors throughout the space. With utilities penalizing for poor power factor, the payback for power factor correction was a no-brainer.

Motors cause poor power factor and with this quantity of horse power, a study was certainly warranted to determine what type of correction to install – static units at large motors or an automatic unit at the service entrance. Additionally, utility rates, motor locations, sizes and quantities vary plant to plant so a study made good sense.

Power Factor is the ratio of active (real) power kW divided by the total (apparent) power kVA. Poor power factor is primarily caused by inductive loads. Most loads in modern electrical distribution systems are inductive; i.e. motors, transformers, fluorescent & HID lighting ballasts, and induction furnaces.

PROJECT PROFILE

SHORT CIRCUIT ANALYSIS

South Dakota State University
Animal Disease Research
& Diagnostics Lab

Brookings, SD

SHORT CIRCUIT ANALYSIS

TAKING THE FAULT

A new 12,470 Volt loop extension & re-route was provided to add a new a 1,500 KVA transformer for the addition. A second 2,500KVA transformer & Pad mount switch were added to the chiller plant along with another 4000A switchboard to support doubling the plants capacity. The switchboards were connected together with main-tie-main breakers and bus duct. The addition was provided with an interior 750 KW diesel generator for life safety needs and the extensive equipment needs of the facility.

This project required several scenarios to be run during the studies due to an emergency source (generator) and two normal power sources via 15kV loop feed to the building. Ratings vary based on which power source is present. After all scenarios are run, the worst case is used to size and rate the equipment.

Short circuit analysis ensures equipment can take the potential electricity when a fault occurs. We certainly want the equipment to withstand these events and not blow up in our face. Running the study is required on every project so equipment is sized and ordered correctly.

If unusually high currents exceed the capability of protective devices (fuses, circuit breakers, etc.) in the power system, a short-circuit can cause the devices to explode like a bomb. In order to identify these hazards before they occur is to perform a short circuit/protection coordination study of the electrical system. **A Short Circuit Analysis** is a study of an electrical system that determines the magnitude of the currents that flow during an electrical fault. Comparing these calculated values against the equipment ratings is the first step to ensuring that the electrical system is safely protected. Once the expected short-circuit currents are known, a protection coordination study is performed to determine the optimum characteristics, ratings and settings of the power system "protective devices" (such as a fuse or circuit breaker). An electrical power system is designed so that if a short-circuit occurs, these devices will operate to "open the circuit" and prevent the continued flow of electrical energy to the faulted area. To minimize interruption of electrical service to other areas of the power system, the system is also designed so that the protective device closest to the short-circuit operates first to "clear the fault."

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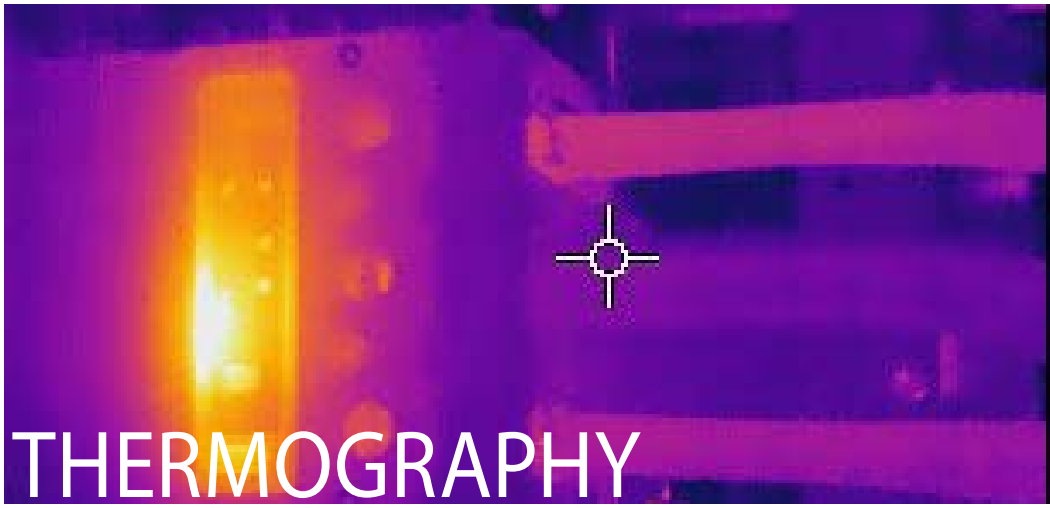
PROJECT PROFILE

THERMOGRAPHY STUDY

Pioneer Memorial Hospital
Viborg, SD



THERMOGRAPHY

Infrared Thermography detects infrared energy emitted from an object, converts it to temperature, and displays an image of temperature distribution (writing with heat).

DETECTING DEFECTS

Pioneer Memorial Hospital is a multi-faceted facility with an inpatient/outpatient hospital, emergency room, clinic, physical therapy, nursing home, assisted living, independent living and memory care.

This project consisted of all new service entrance and complete generator backup. With 52 new and replacement pieces of equipment, including 9 transfer switches, this was a prime candidate for thermography. It took a full day to complete the 150 thermal scans required to verify all electrical connections. All connections had to be under load, including the generator.

By performing the thermography study, we were able to significantly reduce unscheduled power outages by finding any potential problems early, detect problems without interrupting service, assist in corrective action, minimize preventative maintenance and troubleshooting time and check for defective equipment while it was still under the manufacturer's warranty.