FLUKE®

Automating 3,600 bus drop tests at Three-C Electrical

Application Note

Testing Functions
Case Study

Tools: Fluke 8845A 6.5 Digit Precision Multimeter

Tester: Ted Malloy, Project Engineer, Three-C Electrical Company

Tests: Developing automated test protocol to measure performance of 120/208 volt bus drops; load tests and line-to-neutral test; resistance

Three-C Electrical Company is one of the largest independent testing companies in New England. The company was recently asked by a major high-tech manufacturer to help it improve the safety of a large manufacturing facility. The manufacturing facility has many electrical buses running across its ceiling with 3600 drops running down to receptacles for equipment used to build and test its products. The drops are used to power manufacturing and testing equipment that is moved around the plant as needed.

Testing challenge

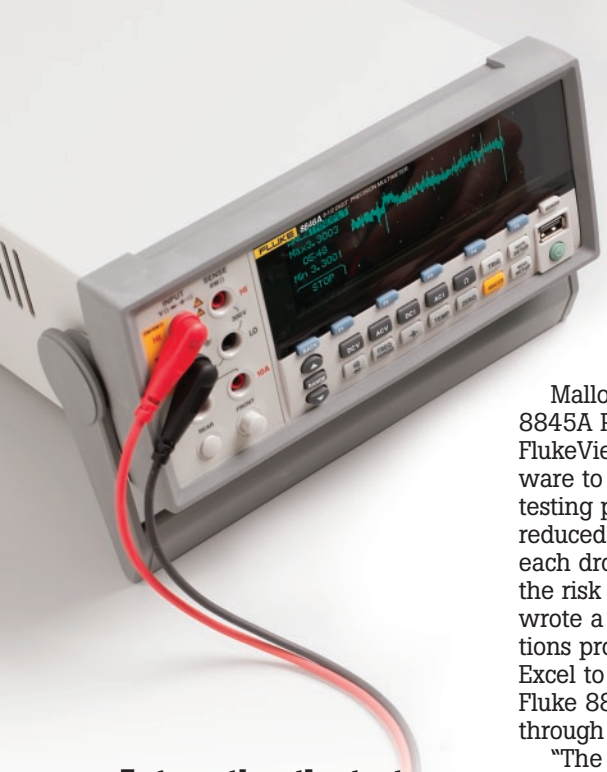
The manufacturing company made the decision to begin testing the bus drops on a regular basis to ensure the safety of employees and avoid downtime. The bus drops deliver three-phase 120/208 volt service. Bus drop performance is particularly important in rooms used for environmental testing because temperatures in these rooms are often raised to high levels, which creates additional risk in the case of a deteriorated connection. These bus drops are in continuous use on the manufacturing floor so testing needs to be performed as quickly as possible to avoid disrupting production.

Ted Malloy, Project Engineer for Three-C Electrical Company, was assigned the task of developing a testing plan. He started out by testing a few bus drops to get his arms around the application. "The critical concern from a performance standpoint is the voltage drop under load," Malloy said. "This helps identify a bad or deteriorating connection that might cause downtime or, in a worst-case scenario, a fire. We also need to make sure the drops are properly grounded to protect operators of the equipment that is connected to them."

"It's critical that these tests be performed quickly and that the results are properly documented," Malloy added. "It would have taken an enormous amount of time for a person to go around with a multimeter to test each of these drops and record the results on paper or a spreadsheet. Our customer was looking to us to engineer a solution that would automate the process in order to perform the tests much more quickly. Our customer also wanted the results to be delivered in a secure electronic format."

Malloy began by working in the plant to prove out a series of tests. He worked with a load bank that made it possible to apply a wide range of resistance to each receptacle. Testing the voltage drop at different loads makes it possible to identify loose and deteriorating connections that could not be detected by a simple voltage test. He found a couple of bus drops that exceeded the standard of a 3 % voltage drop at a 100 % load.

Malloy tested the ground by measuring the resistance between the ground connection on the receptacle and neutral line. He also checked the circuit breakers on the drops by putting the rated amount of current through the breaker to check to make sure they tripped. Finally, he performed a visual inspection of each drop to check for fraying cords and make sure the on and off switch was properly labeled.



Automating the tests

Malloy got the customer's approval for the rigorous series of tests he developed. But performing tests and recording the results manually would have taken about 15 minutes for each bus drop. It would have taken perhaps another five minutes to later enter the results of each test into a spreadsheet or database. So it would have taken approximately 1200 hours or 150 8-hour days to test each of the drops in the plant and record the results.

A testing program of this magnitude would have been very expensive and disruptive to the plant. With many different tests to perform under time pressure, the risk existed that a technician would skip some tests or perform other incorrectly. Another concern is that the manual recording of results would create the potential for data entry errors.

Malloy utilized the Fluke 8845A Precision Multimeter and FlukeView® Forms document software to develop an automated testing program that substantially reduced the time required to test each drop, while also eliminating the risk of data entry errors. He wrote a Visual Basic for Applications program that runs within Excel to issue commands to the Fluke 8845A Multimeter to run through each of the tests.

"The 6.5 digit accuracy of the 8845A reduces the possibility of measurement error and increases our confidence in the measurements," Malloy said. "Yet the 8845A costs 20 % less than other leading 6.5 digit bench DMMs. The ability of the 8845A to accept commands through a serial connection was also very important to the success of this application."

Ensuring accurate results

Before each test, the program prompts the operator to switch the load bank to deliver the correct amount of resistance. FlukeView Forms software transfers each measurement reading from the 8845A multimeter to an Excel spreadsheet. The program includes nine load tests for each of the two receptacles in each drop plus a line-to-neutral test for a total of 19 tests per drop. The program completes the tests in about two minutes. The operator can watch the values dropping into the spreadsheet as the tests are performed. Any measurements that are outside the acceptable limits are automatically highlighted in red using conditional formatting in Excel.

As a proof of concept, Malloy brought his equipment to the plant and demonstrated the 139 drops in two days. Some of the two days were spent in working out kinks with the program. Now that the program has been validated, Malloy estimates that it will test a single bus drop in only two minutes and test 200 bus drops one day. This compares to a maximum of 24 drops that could be tested in one day using the manual approach.

"The speed of the automated testing process makes it possible for the plant to achieve a higher level of safety while minimizing the downtime required for testing," Malloy said. "Automated testing also makes it possible to perform a much broader battery of tests and ensures that the results are accurately recorded. Our plan is to further increase testing speed and reduce the potential for error by adding a barcode on each drop that can be scanned as part of the testing process."

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