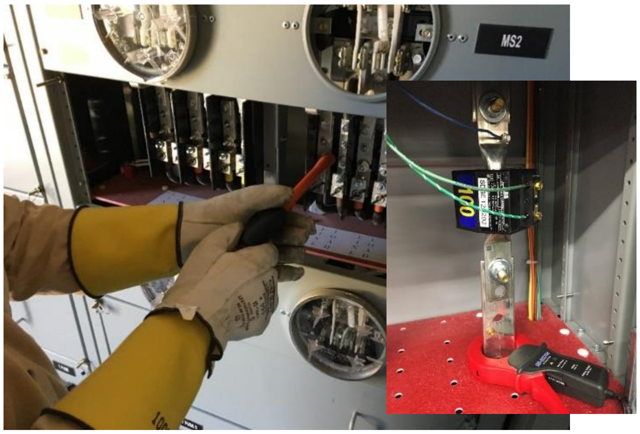
Arc Flash Testing of 480-V Bypass Meter Sockets and CT Cabinets



Bypass meter sockets and CT cabinets

- Determine sustainability for various bypass configurations and CT cabinets
- Develop simple modifications that could reduce sustainability

Background, Objectives, and New Learnings

Arc flash protection is now required for utilities per OSHA 1910.269. This requires utilities to perform incident energy estimates for all equipment. 480-V equipment can have particularly high incident energies, but the results vary dramatically by equipment. Previous testing performed by EPRI determined some 480-V equipment had limits on the incident energy because geometry and spacing in the equipment prevented arcs from sustaining indefinitely. These limits helped inform the NESC standard.

With discrete limits on the duration of the arc, incident energy estimates were low enough to make reasonable levels of arc flash PPE adequate to perform work. However, bypass meter sockets had only two tests done on one specimen, and only one CT cabinet was tested. These tests are insufficient to draw any definitive conclusions. The two test conducted did self-extinguish in under 10 cycles and produced under 8 cal/cm^2.

Without adequate test data, incident energy estimates must use duration limits by system protective devices (usually the high-side fuse on the transformer) or two seconds which is considered the maximum self-extraction time. Using IEEE 1584 formulas with these clearing times produces incident energies (IE) Shown in Table 1.

Table 1: Incident energies based on transformer size

Transformer Size KVA	IE Range, cal/cm^2
75	<8
150	10-15
300	12-25
500	12-40
750	20-55
1000	30-75
1500	60-100
2000	120-160

Bypass meter sockets are installed to allow meter replacement without de-energizing the customer. The bypass switch below the meter socket allows a shunt to be installed between the incoming and outgoing source and a disconnect device to de-energize the meter socket. The meter can then be pulled and reset with the jaws de-energized. These were specifically created to reduce the risk to the employee pulling and setting a meter. However, the act of bypassing and de-energizing at the bypass switches remains a very dangerous activity. Design of the bypass switch is intended to reduce the probability that an employee makes a mistake, but the risk is not zero. Equipment failure or inadvertent contact to ground could still occur.

As can be seen in Table 1, with any transformer size above 500 kVA, it becomes very difficult to perform this bypass action—incident energies are too high for normal PPE. At 2000 kVA, there is no alternative but to de-energize the customer (which defeats the purpose of installing the bypass switches in the first place). More testing could definitively assess the hazards of meter sockets of this type. Other configurations of this system are also used in large customer switchgear line-ups, which will also be tested to define hazard levels.

As with bypass meters, CT cabinets are another location requiring access, often for testing. Without supporting test data, these have the same incident energy ranges shown in Table 1.

Benefits

This project aims to clearly define existing hazards, based on actual testing, to show employers the hazard and allow employers to provide sufficient PPE.

Results may give utilities easy design modifications that could reduce hazard levels to their employees. If test results show that work can be done live, this will improve reliability and safety for the end user and the public.

We hope to address several research questions:

- What is the maximum duration based on sustainability for various types of meter bypass configurations and CT cabinets?
- What is the maximum incident energy based on configuration, fault current, and equipment type?
- How does transformer size and fault current affect sustainability?
- What modifications could be done to reduce sustainability and hazards?

Project Approach and Summary

Project work will include several tasks:

Task 1: Industry equipment: The project team will use surveys with interviews with the participant utilities to determine the various types of bypass sockets used.

Task 2: Develop modifications: The project team will work with participants to determine simple modifications that could be easily implemented.

Task 3: Testing. Testing on all specimen to determine maximum sustainability and incident energy both before and after modifications. The testing lab is to be determined. Participants will be invited to attend the testing.

Deliverables

The main product deliverable will be a technical update summarizing the results of testing. Best practices for modification and protection options will be identified.

Price of Project

The cost is $40,000 per participant plus equipment specimens for testing. Five utility participants are expected to execute the full scope of the project. The project needs full participation to begin.

Project Status and Schedule

Once funded, the project is expected to take eight months for the full project scope.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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