Field Testing

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Polyphase Track

Premise

- Over much of the 20th century, utilities, regulators and customers each relied upon lab and field meter testing efforts which were primarily focused upon the accuracy of the watt-hour meter and demand register.

- This focus is now changing with overwhelming deployment of electronic meters and significant deployment of AMR and AMI meters throughout the installed base in North America.

- The focus has now shifted to the metering installation as a whole and not the accuracy of the meter.

Field Testing

Common Features and Common Sources of Concern

Electro Mechanical meters were subject to registration errors caused by mechanical issues with moving parts resulting in either the loss of revenue to the utility or over billing for the customer. Some of the more common problems were:

- Friction wear
- Gear mesh misalignment
- Retarding magnet failure
- Timing motors

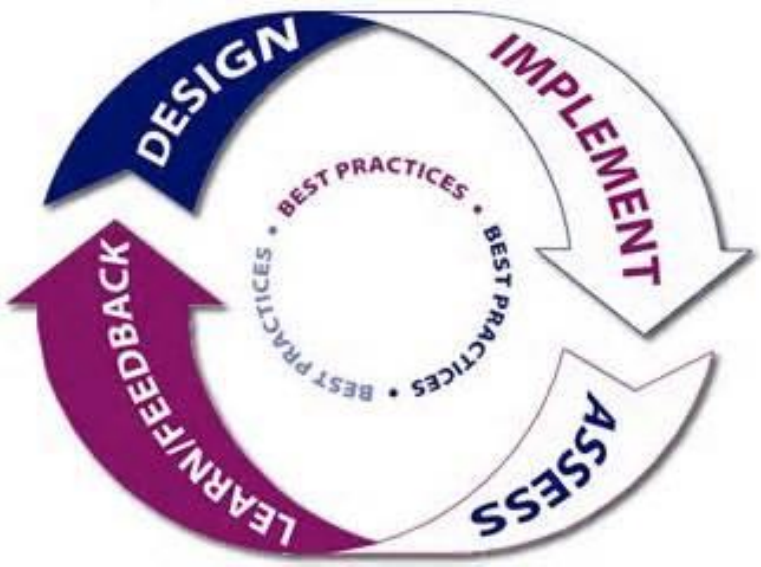
Electronic Meters – new failure modes require new testing and inspection methods

Electronic meters fail as do electro mechanical meters but differently

- Their overall life expectancy is not nearly the same
- Failure modes include drift (unexpected)
- Failure modes include catastrophic (expected)
- Failure modes include non-catastrophic but significant measurement error modes
- Failure modes can include non-measurement issues which render the meter ineffective or inaccurate for billing purposes.

Best Practices

- Residential vs Commercial
- Self-Contained vs Transformer Rated
- Follow the money and be as proactive as possible



Potential Site Check List

- Double check the meter number, the location the test result and the meter record
- Perform a visual safety inspection of the site. This includes utility and customer equipment. Things to look for include intact down ground on pole, properly attached enclosure, unwanted voltage on enclosure, proper trimming and site tidiness (absence of discarded seals, etc.)
- Visually inspect for energy diversions (intentional and not). This includes broken or missing wires, jumpers, open test switch, unconnected wires and foreign objects on meters or other metering equipment. Broken or missing wires can seriously cause the under measurement of energy. A simple broken wire on a CT or VT can cause the loss of 1/3 to 1/2 of the registration on either 3 element or 2 element metering, respectively.
- Visually check lightning arrestors and transformers for damage or leaks.
- Check for proper grounding and bonding of metering equipment. Poor grounding and bonding practices may result in inaccurate measurements that go undetected for long periods of time. Implementing a single point ground policy and practice can reduce or eliminate this type of issue.
- Burden test CTs and voltage check PTs.

Potential Site Check List (cont)

- Verify service voltage.
- Check that the transformers are wired correctly.
- Verify condition of metering control wire. This includes looking for cracks in insulation, broken wires, loose connections, etc.
- Compare the test switch wiring with the wiring at the CTs and VTs. Verify CTs and VTs are not cross wired. Be sure CTs are grounded in one location (test switch) only.
- Check for bad test switch by examining voltage at the top and bottom of the switch. Also verify amps using amp probe on both sides of the test switch. Verify neutral connection to cabinet (voltage).
- Check rotation by closing in one phase at a time at the test switch and observing the phase meter for forward rotation. If forward rotation is not observed measurements may be significantly impacted as the phases are most likely cancelling each other out.
- Test meter for accuracy. Verify demand if applicable with observed load. If meter is performing compensation (line and/or transformer losses) the compensation should be verified either through direct testing at the site or by examining recorded pulse data.

Potential Site Check List (cont)

- Verify metering vectors. Traditionally this has been done using instruments such as a circuit analyzer. Many solid state meters today can provide vector diagrams along with volt/amp/pf and values using meter manufacturer software or meter displays. Many of these desired values are programmed into the meters Alternate/Utility display. Examining these values can provide much information about the metering integrity. It may also assist in determining if unbalanced loads are present and if CTs are sized properly. The vendor software generally has the ability to capture both diagnostic and vector information electronically. These electronic records should be kept in the meter shop for future comparisons.

- If metering is providing pulses/EOI pulse to customers, SCADA systems or other meters for totalization they also should be verified vs. the known load on the meter.

- Verify meter information including meter multiplier, serial number, dials/decimals, Mp, Ke, Primary Kh, Kr and Rate. Errors in this type of information can also cause a adverse impact on measured/reported values.

- Verify CT shunts are all opened.

Shop Testing

- Accuracy Testing
- Meter Communications Performance
- Software & Firmware Verification
- Setting Verification
- Functional Testing
- Disconnect/Reconnect Functionality
  and as left setting

What are we looking for?

- Incorrect firmware
- Bad settings
- Alarms and errors that do not clear
- Communication test failures
- Bad tables
- Failed disconnect switches

Field Testing

- Accuracy Testing
- Meter Communications Performance
- Software & Firmware Verification
- Setting Verification
- Functional Testing
- Disconnect/Reconnect Functionality and as left setting
- Tamper Verification
- Site Audits appropriate to the type of meter

RMA's, Root Cause Analysis and In Service Testing

No one knows the actual life of their AMI meter. To do this we must learn as much as we can from the failures and the performance of the meters we have deployed.

Opportunities to Learn:

- Meters returned from the field as bad or flagged on incoming inspection. These RMA's need to be tracked not only for warranty purposes but more importantly to understand the root cause of the issues.
- In Service Test programs need to be utilized to understand the overall performance of AMI meters and as failures are identified these meters need to be dissected and the failure mode understood. If necessary, once the failure mode is understood the meter population may need to also be dissected to identify sub-groups of meter that may be similarly affected. This could be a group of meters…

  - from the same shipment.
  - that were deployed in the same geographic area.
  - that saw the same type of usage or environment.

Post-Deployment Needs

- AMI Population Management
- Once deployment is complete the certification and acceptance testing does not stop.
- Everyone understands the importance of acceptance testing, but future generations of a smart meter also require certification testing.
- New software and firmware needs to be tested and compared against the performance of older generations.
- New hardware must be tested and compared to older generations.
- Firmware upgrades need to be checked
- New head end systems or IT protocols need to be tested against a large group of meters before going live.

Testing Frequency & Cost

- Tools (hardware and software)
- Personnel
- Frequency
- Test
- Report
- Analyze
- Learn, Share, Adapt

Questions and Discussion

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This presentation can also be found under Meter Conferences and Schools on the TESCO web site:
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