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Identifying Organizational and Quality Control Processes for a Successful AMI Implementation

Quality Control – Monitoring through Statistical Sampling

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The Problem

- Monitoring the In-Service performance of our metering infrastructure is no longer just about verifying the accuracy of the meter.

Smart Meter

Time

Available Technology and Options

	AMR		AMI	
	Meter Readers	Mobile AMR	Fixed Network	1st Gen	Smart Meter
METER FEATURES					
Scheduled Monthly Reads	X	X	X	X	X
Automated Monthly Reads		X	X	X	X
TOU Metering			X	X	X
Two-way Communications to the AMI Module			X	X	X
Hourly Data (# Channels, Interval length, storage)				X	X
VPP Rates (including CPP and RTP rates)				X	X
Outage Management (Super					X
Two-way Communications to					X
Solid State Meters - 100%					X
St					X
St					X
Se					X
Lo					X
Re					X
Re					X
Bi					X
Re					X
M					X
D					X
P					X
Ho					X

Two-way Communications to the meter →

Solid State Maters – 100% →

Standard Communications: ANSI C12.22, IP2 →

Standard Data Model – ANSI C12.19 →

Security Meter Communications LAN, HAN →

Local Meter Communications (Optical, Radio) →

Remote Meter Programming →

Remote Meter Firmware (Meter, LAN, and HAN) →

Bi-directional metering & Net Metering (DG) →

Reactive Metering →

Meter Service Switch →

Demand kW Reading for each customer →

Power Quality Measurement (Voltage, ...) →

Home Area Network (Gateway in Meter?) →

- What are we going to check and how are we going to check these things?
- Some are familiar – meter accuracy.
- Some are becoming familiar – meter communication module
- Some are new – built in service switch
- New features will be added

- Metering has been transformed over the past 20 years and continues to change as we move through AMR and now AMI implementations.
- Once upon a time gross metering inaccuracies were recovered in the next rate case.
- The accuracy and reliability of the meter is now integral to the success of the business case as we roll out these Advanced Meter Infrastructures.

- Or is this a case of Back to the Future?

- The fundamental issues are all familiar to us.
- The new issues are just new versions of standard issues.
- Many of the tools we have been using are still viable, but the processes need to be revamped.

What are the steps?

- Establish guidelines for deciding what needs to be checked, then make those decisions.
- Once we have decided what needs to be checked we need to decide how we are going to check.
- Using the techniques available to us we then need to decide what process we will be using.

What needs to be checked?

This will change and continue to evolve throughout the foreseeable future. Some likely candidates;

- Meter Accuracy
- Meter and Transformer wiring
- Size and nameplate information of instrument transformers
- Two way communication functionality
- Communication strength
- Meter Service Switch Functionality

Decisions to Make

- We need to determine which factors are important to our business right now.
- We also need to determine at what frequency we will review these needs. We need to make sure that we develop a process dynamic enough to keep up with our company's changing needs.

How are we going to check?

- Visit or Remote?
- Test or inspection?
- Functional test or accuracy test?
- Visual inspection or an operational verification?

What Process to Use?

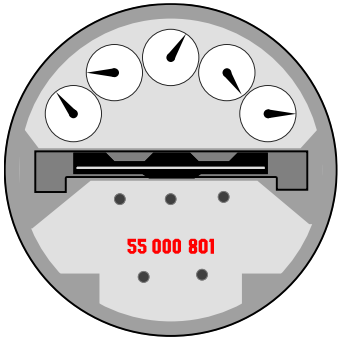
- Historically we have used some sort of statistical sampling to monitor the performance of our in-service meter population coupled with the reports from on-site service reports (e.g. meter reads and service calls)

- Without the eyes on the meter we are going to have to rely on some sort of statistical service plan coupled with service calls internally or customer generated.

- Currently we all know and acknowledge that we need to do more and not less verification of our meter installations for our C&I customers.
- We need to take our “best practices” as discussed in this working group and internal working groups and include these overall meter installation inspections into our in-service testing data base. From here we need to add the new features that also need to be tested and tracked.

What is Statistical Testing?

Statistical testing is the testing of a population or group for specific characteristics or parameters using a valid statistically-derived sampling plan.



Features of a Statistical Testing Plan:

- ***Homogeneous Population(s)***
- ***Sample(s) of a Suitable Size for the Plan***
- ***Random Sample Selection of Items to Be Tested***
- ***Expectation that the Group or Population Being Tested Fits the Statistical Model***

ANSI C12.1 references the two primary statistical sampling plans commonly used for in-service meter testing:

- ***ANSI ASQ Z1.4,*** *Sampling Procedures and Tables for Inspection by Attributes*
- ***ANSI/ASQ Z1.9,*** *Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming*

ANSI/ASQ Z1.4:

- Based on MIL-STD-105
- Uses attributes (pass/fail, yes/no, etc.) as the basis for analysis
- Variety of special and general inspection levels
- Various sampling plans (single, double, & multiple)
- Wide range of Acceptance Quality Limits (AQL's)

ANSI/ASQ Z1.9:

- Based on MIL-STD-414
- Use variables (a measured parameter or characteristic) as the basis for its analysis. This is normally weighted average for electric meters.
- Variety of special and general inspection levels
- Selection of Acceptance Quality Limits (AQL's)

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Most of the features to be monitored should be monitored using an attributes based plan. These plans would be based on ANSI/ASQ Z1.4

However, features such as meter accuracy and possibly even some communication features would be better measured using a variable based method.

A hybrid plan can be implemented where all factors would be monitored using an ANSI/ASQ Z1.4 plan and meter accuracy would also be monitored using an ANSI/ASQ Z1.9 plan.

Here is an example of a report from a hybrid system that is monitoring meter accuracy and ERT functionality for in service meters.

Status: PASS

Meter Group	Manuf. Model	Meter Type Code	AMR Device	Meter Population	Tested Amount	Required Amount	Z1.9 Current %NCF	Z1.9 Allowed %NCF	Z1.9 Status	Mean	Std Dev	Z1.4 Allowed Failures	Accuracy Failures / Status	ERT Failures / Status	Display Failures / Status	ERT / Display Mismatch Failures / Status
01	C1SR	F0139	ERT	525040	114	1250	0.006	4.39	pass	100.1	0.0806	21	1 / pass	1 / pass	1 / pass	1 / pass
03	CN1SR	F0209	ERT	69714	189	500	0.006	4.42	pass	100.0	0.0454	21	1 / pass	1 / pass	1 / pass	1 / pass
06	A3T	F8000	DEMERT	43484	490	500	0.008	4.42	pass	99.99	0.0433	21	5 / pass	0 / pass	0 / pass	0 / pass
07	C1SR	F0139	R300	38816	260	500	0.008	4.42	pass	100.0	0.0755	21	0 / pass	0 / pass	0 / pass	0 / pass
08	ABS5	F0209	ERT	38691	1	500	0	4.42	pass	100.4		21	0 / pass	0 / pass	0 / pass	0 / pass
12	A3T	F8000	ERT	15885	150	315	0.006	4.67	pass	99.97	0.0448	14	0 / pass	0 / pass	0 / pass	0 / pass
25	ABS3	F0229	ERT	1429	10	80	0	5.21	pass	100.4	0.2887	7	0 / pass	0 / pass	0 / pass	0 / pass

- We need to understand what needs to be checked and that this list will change as the business needs and technology changes.
- We need to understand how we can check and what information we can report.
- We need to quantify the impact of various failures and determine adequate risk levels.

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Q&A

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