COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

APPLICATION OF FARMERS RURAL ELECTRIC COOPERATIVE FOR ADOPTION OF A SAMPLE METER TESTING PROCEDURE	)))	CASE NO. 2013-00186

ORDER

On May 13, 2013, Farmers Rural Electric Cooperative Corporation ("Farmers RECC") filed an application seeking approval for the adoption of a meter-testing program in accordance with 807 KAR 5:041, Section 16, Sample Testing of Single Phase Meters.

Farmers RECC is a member-owned electric distribution cooperative organized pursuant to KRS Chapter 279 with its principal business office located in Glasgow, Kentucky. Farmers RECC provides electric service to approximately 24,839 members in all or portions of Adair, Barren, Edmonson, Grayson, Hart, Larue, and Metcalfe counties in Kentucky. Farmers RECC has fully deployed automated meter-reading technology that includes service to all single-phase residential and commercial customers by solid-state digital electronic meters.

In its initial application, Farmers RECC generally described the methods and procedures it plans to follow when conducting sample testing of single-phase meters. Upon review of the initial application, Commission Staff issued a request for additional

information.[1] Farmers RECC provided, as part of its response, a revised application on July 12, 2013. Commission Staff subsequently issued another request for additional information,[2] to which Farmers RECC provided its response on September 27, 2013, that, again, included a revised application (2nd Revision). On November 26, 2013, an informal conference was held at the Commission's offices in Frankfort, Kentucky, between Commission Staff and representatives of Farmers RECC to discuss and clarify certain aspects of its revised application.

The record for this proceeding is now complete, and as further provided for herein, the Commission finds that Farmers RECC should be granted approval to adopt a sample testing program in accordance with 807 KAR 5:041, Section 16, and as described in Farmers RECC's 2nd Revision. In addition, the Commission directs Farmers RECC to provide additional reporting related to its sample testing program to ensure the accuracy of meters and the overall integrity of Farmers RECC's metering system.

FARMERS RECC APPLICATION

According to its application, as revised, Farmers RECC intends to utilize the statistical sampling methodology prescribed by the American National Standards Institute/American Society for Quality Control[3] (ANSI/ASQC) Z1.9-2008 (Sampling

[1] Commission Staff's First Request for Information (Ky. PSC June 18, 2013).

[2] Commission Staff's Second Request for Information (Ky. PSC Sept. 13, 2013).

[3] The American Society for Quality Control is now known as the American Society for Quality (ASQ) and is a members-based organization.

Procedures and Tables for Inspection by Variables for Percent Nonconforming).[4] This standard has been used as the basis for a number of electric utilities' sample testing programs.

Farmers RECC is currently on schedule with its periodic meter-testing program as prescribed by 807 KAR 5:041, Section 15, and primarily performs in-house testing of meters, but also has arrangements with Commission-approved meter-testing facilities for testing as needed. Farmers RECC asserts that adopting a sample testing program will result in estimated savings of $564,000 over the typical eight-year periodic testing cycle without sacrificing meter-testing accuracy or the overall integrity of its metering system.[5]

[4] ANSI/ASQ Z1.9-2013 is the current version of the standard and includes very minor (typographical) revisions to the 2008 version. ANSI/ASQ Z1.9 is an acceptance sampling system to be used on a continuing stream of lots under inspection for a specified Acceptance Quality Limit ("AQL"). The methodology provides tightened, normal, and reduced inspection plans to be used on populations which have normally distributed test characteristics. Pursuant to the methodology, the variation in measurements may be evaluated by determining the sample's standard deviation, the sample's range or utilizing a known standard deviation of the population. The methodology is applicable only when the normality (Gaussian distribution) of the quality measurements for the group under inspection is assured.

[5] It should be noted that Farmers RECC's analysis presumes the proposed sample testing will not result in unacceptable performance for any lot under inspection, thereby avoiding any estimated expenses associated with further testing that may be required to verify meter accuracies within a group/lot.

Farmers RECC has identified the following homogeneous test groups that are planned to be utilized for sampling:

Group	Manufacturer	Type	Form	Population
1	Itron	C1S	2S	25080[6]
2	Itron	C1S	2SE	582
3	GE	I-210+	2S	100

Farmers RECC will employ a computerized process utilizing billing system records for randomly selecting meter units from each group/lot of installed meters up to the necessary sample size. Non-registering meters in a sample will be replaced with another randomly selected sample meter from the lot under inspection.[7] Consistent with ANSI/ASQ Z1.9, each group/lot will be sampled and tested for acceptance at Inspection Level II, which corresponds to a "default" level of normal discrimination deemed appropriate absent circumstances or conditions that might warrant the need for a greater or lesser inspection level.

Farmers RECC indicates that it intends to use an AQL of 2.5 percent nonconforming (i.e., defective) as the basis for determining the acceptance of installed meter groups/lots.[8] Newly installed meters will be eligible for selection as a sample from the assigned group/lot in the year following being placed in service. New meters, as

[6] The meter population for Group 1 will be further divided into subgroups, or lots, of no more than 1,500 units based on serial number break-points.

[7] As explained later, this approach is a potential area of concern and was discussed during the November 13, 2013 Informal Conference.

[8] Farmers RECC's explanation for deriving the AQL of 2.5 percent nonconforming is inconsistent with ANSI/ASQ Z1.9, but Commission Staff clarified the terminology during the Informal Conference, and Farmers RECC expressed its intent to select the value consistent with other sampling plans approved by the Commission.

purchased and prior to being placed in service, will be sample tested in lots established just for "new" meter testing and will be subject to a more stringent AQL of 1 percent nonconforming.

Farmers RECC proposes to use a +/- 2 percent double specification limit for accuracy measurements, i.e., the accuracy of a meter under test will be accepted if its average meter registration falls within the upper limit of 102 percent (fast) and the lower limit of 98 percent (slow). The variability in measured accuracy of units within the lot under test is assumed to be unknown, and the standard deviation method will be employed to evaluate the estimated percentage non-conforming of the lot, which will then be compared to the derived maximum allowable percentage non-conforming (based on an AQL of 2.5) to determine acceptance of the lot.

Pursuant to 807 KAR 5:041, Section 14, all meters will be tested at full load ("FL"), light load ("LL"), and 50 percent power factor, but only the FL and LL test results will be evaluated to determine the acceptance of the lot. If a sample fails to meet the specified AQL, the entire group/lot will be tested within 18 months. No meter will remain in service for more than 25 years without testing, regardless of the associated group/lot performance.

Farmers RECC has committed to test a percentage of meters in addition to the samples selected from each group/lot, as prescribed by 807 KAR 5:041, Section 16(4)(a), based on the prior year's test results. These additional meters should be selected from meters in each group/lot longest in service since the last test or may be selected from meter types known to be affecting a group/lot's accuracy performance.

DISCUSSION

The Commission has approved sample testing plans for several jurisdictional electric utilities, and each plan is based on substantially the same methodology and procedures provided for in the current version of ANSI/AQC Z1.9. However, many of the plans contain provisions on a few significant aspects of sample testing that could impact the representation of the expected accuracy of the meter lots under inspection and the integrity of a utility's metering system.

The first and most significant concern involves the use of +/- 2 percent as the acceptable accuracy (i.e., upper/lower specification limit) for a sample meter under test. Regardless of the determination relative to the group/lot under inspection, a significant number of units tested may exhibit an accuracy tolerance outside that allowed by 807 KAR 5:041, Section 17(1), i.e., +/- 1 percent, without affecting the overall acceptance of the group/lot. Depending on the occurrence of individual test results falling within 1 and 2 percent under- or over-registering, such test results within a sample may indicate the probable existence of meters within the group/lot with registration errors that would not be in compliance with the Commissions' accuracy requirements. While the Commission recognizes that KRS 278.210 establishes that a utility may demonstrate in an application for sample testing that no significant number of meters over-register by more than 2 percent, the Commission notes that this is a threshold typically reserved for the application of "billing adjustments" and finds that additional reporting should be established to ensure that the results of sample testing are not indicative of what may

be significant accuracy issues effectively absolved by the use of a +/- 2 percent accuracy specification limit.

A similar concern with Farmers RECC's application that also exists in other electric utilities' sample testing plans involves the procedure of replacing "non-registering" meters found within a sample with properly registering units to continue evaluating the acceptance of the group/lot. Depending on the frequency and nature of the conditions that render meters non-registering within a sample, it is possible that the occurrence of non-registering meters is indicative of such conditions being found within the group/lot under inspection. ANSI/ASQ Z1.9 at Section A7.2 requires that the "[u]nits of a sample shall be selected at random without regard to their quality," which implies that even if the selection process is entirely random both for the original unit and its replacement, a non-registering meter condition should be accounted for in some manner, as it may well indicate quality issues beyond meter accuracy that should be evaluated by a utility to ensure the integrity of its metering system.

Sampling plans that the Commission has approved differ in the manner in which the average meter registration is calculated for a unit under test. Farmers RECC's plan, along with other sampling plans, specifies that the average meter registration will be evaluated using a simple average of the FL and LL test results, i.e., (FL + LL) / 2, consistent with 807 KAR 5:041, Section 17(1)(c), while some plans use a weighted average, i.e., (4 X FL + LL) / 5, and others use only the FL to evaluate a meter's accuracy. Although the approaches vary among utilities, it is desirable for all utilities to administer tests consistently on the same class of meters. The efficacy of any particular

approach is difficult to determine without specific test results and is why additional reporting requirements are required of Farmers RECC.

The Commission finds that Farmers RECC's application, as revised, for a sample testing plan should be approved with additional reporting requirements to demonstrate that the testing plan effectively assures the accuracy of meters in-service.

IT IS THEREFORE ORDERED that:

1. Farmers RECC is granted approval to adopt a sample testing program in accordance with 807 KAR 5;041, Section 16, and as provided for in Farmers RECC's 2nd Revised Application, submitted on September 27, 2013, and attached as an Appendix to this Order.

2. Farmers RECC shall comply with all applicable meter-testing requirements contained in 807 KAR 5:006 and 807 KAR 5:041, including maintaining all meter test records related to its sample testing in accordance with 807 KAR 5:006, Section 18.

3. Farmers RECC shall notify the Commission in writing of any intentions to adjust, alter, amend, or otherwise deviate from the sample testing plan provided for herein, including notice of a decision to abandon sample testing and return to periodic testing of meters as prescribed by 807 KAR 5:041, Section 15.

4. Farmers RECC shall provide the additional information listed below with its Quarterly Meter Reports, which are required to be filed by 807 KAR 5:006, Section 4(4), and include an electronic version compatible with Microsoft Excel.

a. A detail report in a tabular format that records the following information for each meter, including new meters, tested under the sampling plan:

(1) Serial Number;

(2) Date/Time of Test;

(3) Manufacturer;

(4) Model/Form/Type;

(5) Version/Firmware;

(6) As-Found Meter Registration, FL, LL, and Power Factor Results;

(7) As-Left Meter Registration, FL, LL, and Power Factor Test Results; and

(8) Description of Any Billing Adjustment.

b. An "exception" report in a tabular format that lists the following information for each meter removed from a sample and replaced with another unit due to a "non-registering" condition or any other condition that prevents the meter from being tested:

(1) Serial Number of Replaced Meter;

(2) Manufacturer;

(3) Model/Form/Type;

(4) Version/Firmware;

(5) Serial Number of Replacement Meter;

(6) Date of Replacement;

(7) Description of Meter Condition and Suspected Cause of Damage/Defect; and

(8) Description of any Billing Adjustment.

By the Commission

ENTERED
AUG 0 8 2014
KENTUCKY PUBLIC
SERVICE COMMISSION

ATTEST:

Executive Director

APPENDIX

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2013-00186 DATED AUG 0 8 2014

REQUEST TO ADOPT SAMPLE TESTING METHOD FOR FARMERS RURAL ELECTRIC COOPERATIVE CORPORATION'S SINGLE-PHASE METERS

2nd Revision

Farmers Rural Electric Cooperative Corporation
Glasgow, Kentucky

Prepared by
Tony Wells

September 26, 2013

INTRODUCTION

Farmers Rural Electric Cooperative Corporation (FRECC) is an electric distribution cooperative located in south central Kentucky. FRECC is presently on schedule with its eight-year meter testing program. Since 2006, FRECC has been fully automated in single-phase meter reading. By adopting a sample meter testing program, FRECC will take another significant step towards maximizing efficiency in the single-phase meter reading and testing of our operation. It is the purpose of this proposal to demonstrate the methods used and the cost savings achieved in sample testing.

RULES AND REGULATIONS

Kentucky Public Service Commission (PSC) rules regulations outline the required method and techniques of sample meter testing. FRECC will comply with **PSC KAR 5.041E, Section 16** when implementing its sample meter testing program.

Section 16. Sample Testing of Single Phase Meters. A utility desiring to adopt a scientific sample meter testing plan for single phase meters shall submit its application to the commission for approval. Upon approval the sample testing plan may be followed in lieu of the periodic test prescribed in Section 15(3) of this administrative regulation. The plan shall include the following:

(1) Meters shall be divided into separate lots to recognize differences in operating characteristics due to changes in design, taking into consideration date of manufacture and serial number.

(2) The sampling procedure shall be based upon accepted statistical principles.

(3) The same sampling procedure shall be applied to each lot.

(4) Each utility authorized to test meters by sample meter testing plan shall comply with the following conditions:

(a) The number of meters in addition to the sample shall be taken from those meters in each lot longest in service since last test unless a particular meter type is known to be increasing the percentage of meters requiring test for the sample lot. In such a case where a particular meter type is increasing the percentage of meters requiring test in any lot, these meters may be selected first regardless of test date with any additional tests as required for that lot coming from those in that lot longest in service since last test. Each year the utility shall use the following table to determine the percentage of the total meters in each lot to be tested.

Within Limits of 2% Fast or Slow (Indicated by Sample)		Percentage of Meters to be Tested the Next Year
99.0	100.0	2
98.0	98.9	4
97.0	97.9	6
96.0	96.9	8
95.0	95.9	10
93.0	94.9	12
91.0	92.9	14
Less than	91.0	16

(b) Provided, however, that no meter shall remain in service without periodic test for a period longer than twenty-five (25) years.

(5) Whenever a meter is found to be more than two (2) percent fast or slow, refunds or back billing shall be made for the period during which the meter error is known to have existed or if not known for one-half (1/2) the elapsed time since the last test but in no case to exceed three (3) years. This provision shall apply only when sample testing of single phase meters has been approved by the commission and utilized by the utility.

PROCEDURE

As shown in the table below, meters will be divided into various test lots based upon manufacturer and type. Due to a large lot of similar meters installed during AMI installation, the lots will be further divided, to lots no larger than 1500 meters by serial number break points.

Meter Lots

	Manufacturer	Type	Form	Population
1	Itron	C1S	2S	25080*
2	Itron	C1S	2SE	582
3	GE	I-210+	2S	100

*Meter lot 1 will be broken up into lots of 1500 based on serial number

The statistical meter sample testing will follow ***American Nation Standard ANSI/ASQC Z1.9-2008 (Sample Procedures and Tables for Inspection).*** Each test lot will be randomly sampled by a computerized process. The FRECC billing computer will be used for this process.

Part A7. Sample Selection, from the above standard, states that **Inspection Level II** shall be used for the discrimination level. Unless otherwise required by the PSC, this level will be in effect for the FRECC program.

The **Acceptable Quality Limit** (AQL) is defined as the quality level that is the worst tolerable product average when a continuing series of lots is submitted for acceptance sampling. Due to the ±2% limits, the sample lots shall be tested using an AQL of 2.5. This value can be found in Table A-1.

Newly installed meters will be added to the proper lot and will be eligible for sample testing the following year. New meters from a different manufacturer or with different characteristics/features will require the formation of a new lot. As new meters are purchased in lots a sample test lot will be established just for the new meter testing. An AQL of 1.0 will apply to the new meter testing.

Table A-1
AQL Conversion Table

For specified AOL values falling within these ranges			Use this AQL value
–	to	0.109	0.10
0.110	to	0.164	0.15
0.165	to	0.279	0.25
0.280	to	0.439	0.40
0.440	to	0.669	0.65
0.700	to	1.09	1.0
1.10	to	1.64	1.5
1.65	to	2.79	2.5
2.80	to	4.39	4.0
4.40	to	6.99	6.5
7.00	to	10.9	10.0

Table A-2[1]
Sample Size Code Letters[2]

Lot Size			Inspection Levels				
			Special		General		
			S3	S4	I	II	III
2	to	8	B	B	B	B	C
9	to	15	B	B	B	B	D
16	to	25	B	B	B	C	E
26	to	50	B	B	C	D	F
51	to	90	B	B	D	E	G
91	to	150	B	C	E	F	H
151	to	280	B	D	F	G	I
281	to	400	C	E	G	H	J
401	to	500	C	E	G	I	J
501	to	1,200	D	F	H	J	K
1,201	to	3,200	E	G	I	K	L
3,201	to	10,000	F	H	J	L	M
10,001	to	35,000	G	I	K	M	N
35,001	to	150,000	H	J	L	N	P
150,001	to	500,000	H	K	M	P	P
500,001	and	over	H	K	N	P	P

[1]The theory governing inspection by variables depends on the properties of the normal distribution and, therefore, this method of inspection is only applicable when there is reason to believe that the frequency distribution is normal.

[2]Sample size code letters given in body of table are applicable when the indicated inspection levels are to be used.

PROCEDURE(cont.)

Randomly selected meters (lot) from each lot will be sent to the meter shop. All non-registering meters will be replaced by another random selection. The meters will be tested under full load, light load and 50% power factor.

For each lot, calculations will be based on the Double Specification Limit Variability Unknown-Standard Deviation Method. Full Load and Light Load test results will be evaluated. **Example B-4** in ***ANSI/ASQC Z1.0-2008*** demonstrates this calculation method. **Table B-3** is included in this proposal.

The results from each goups's test lot will be examined to determine meter accuracy. If a lot does not meet the AQL standards for the lot size, the entire lot will be tested within 18 months.

No meter shall remain in service without periodic test for a period longer than twenty-five (25) years.

Table B-3 Standard Deviation Method

Master Table for Normal and Tightened Inspection for Plans Based on Variability Unknown
(Double Specification Limit and Form 2—Single Specification Limit)

Sample Size Code Letter	Sample Size	Acceptance Quality Limits (normal inspection)											
		T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		M	M	M	M	M	M	M	M	M	M	M	M
B	3	↓	↓	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69
C	4	↓	↓	↓	↓	↓	↓	1.49	5.46	10.88	16.41	22.84	29.43
D	5	↓	↓	↓	↓	0.041	1.34	3.33	5.82	9.80	14.37	20.19	26.55
E	7	↓	0.005	0.087	0.421	1.05	2.13	3.54	5.34	8.40	12.19	17.34	23.30
F	10	0.077	0.179	0.349	0.714	1.27	2.14	3.27	4.72	7.26	10.53	15.17	20.73
G	15	0.186	0.311	0.491	0.839	1.33	2.09	3.06	4.32	6.55	9.48	13.74	18.97
H	20	0.228	0.356	0.531	0.864	1.33	2.03	2.93	4.10	6.18	8.95	13.01	18.07
I	25	0.250	0.378	0.551	0.874	1.32	2.00	2.86	3.97	5.98	8.65	12.60	17.55
J	35	0.253	0.373	0.534	0.833	1.24	1.87	2.66	3.70	5.58	8.11	11.89	16.67
K	50	0.243	0.355	0.503	0.778	1.16	1.73	2.47	3.44	5.21	7.61	11.23	15.87
L	75	0.225	0.326	0.461	0.711	1.06	1.59	2.27	3.17	4.83	7.10	10.58	15.07
M	100	0.218	0.315	0.444	0.684	1.02	1.52	2.18	3.06	4.67	6.88	10.29	14.71
N	150	0.202	0.292	0.412	0.636	0.946	1.42	2.05	2.88	4.42	6.56	9.86	14.18
P	200	0.204	0.294	0.414	0.637	0.945	1.42	2.04	2.86	4.39	6.52	9.80	14.11
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00	
		Acceptance Quality Limits (tightened inspection)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

COST SAVINGS/CONCLUSION

A substantial reduction in cost will be achieved by implementing the sample meter test method. Once the program is established, only a small percentage of the present labor and testing efforts will be required. This reduction results in a cost savings without compromising single-phase revenue metering accuracy.

Cost Savings to Farmers RECC due to a change to Sample Metering

Assumptions:
Needing to test 1050 sample meters annually
Current practice is to test approximately 3400 meters annually
Contract pricing to test single-phase meter $30

Current Annual Costs

		Cost to test	Annual Cost
Number of meters	3400	$30.00	$102,000.00
Cost of Testing meters over 8 year cycle			$816,000.00

Proposed Sample Testing Costs

		Cost to test	Annual Cost
Number of meters	1050	$30.00	$31,500.00
Cost of Testing meters over 8 year cycle			$252,000.00
Potential Savings over 8 year cycle			**$564,000.00**