APPENDIX 58

Electro-mechanical meter replacement proposal

Energex

Electro-mechanical meter replacement proposal

2015-2020

energex

positive energy

Electricity meters can be logically grouped into two categories, Electronic and Electro-Mechanical. Each category has a unique mode of operation and failure mechanism.

Electro-Mechanical meters can operate for many years with error beyond allowable limits (2%) before they cease to operate and produce an unambiguous sign of failure. Therefore, measurement of meter error through sampling is the most effective way to identify failed meters. In contrast, Electronic meters generally fail to operate as a result of most failure mechanisms thereby capture of the failure is relatively fast and recorded in the meter data systems.

Electro-Mechanical Meters

Energex has been performing sample meter testing according to AS1284.13 (the Standard) for several years and have obtained some 10,000 meter test results. The AS1284.13 sampling plans operate under the AQL methodology. The AQL type of sampling is always heavily in favour of the equipment operator as the sampling plans require an extreme deviation from the desired quality before a rejection (failure) of the sample and population occurs.

An obvious question is;

"*Why do we seem to have so many meters that appear to exceed our tolerable limits if we have been testing and evaluating meters over several years?*"

This is explained by the use of the AQL sampling plans and their intended, poor test power.

The Standard offers two AQLs, 6.5 for Light Load Error and 4.0 for Full Load Error. As both Full and Light Load error are measured on the same meter and are a function of the same mechanism for error, and indicate meter health, either test point result beyond 2% is used as a count of non-conforming (error-meter) with only one count per meter used.

In grouping these failures Energex chooses to use the tighter AQL of the two offered (Full Load) as an upper limit for meter quality. That is, on average, we will not tolerate any more than 4% of our meters being in error at any one time.

Counts of meters with an error at either Full or Light Load greater than 2.0% are given in Table 1, along with an estimate of the proportion of meters affected. Ninety-five percent confidence intervals have been used and should be interpreted as follows;

There is a 95% chance that the interval shown contains the true proportion of meters with error greater than 2%. The true proportion will be missed on average only 5 times in 100.

Table 1 – Meter age groups and there estimated proportion with error greater than 2%

Age of Meters (Years)	Number Tested	Number Failed	Proportion Error >2%	Upper Estimate	Lower Estimate
65-70	44	14	0.318182	0.477	0.185
60-65	375	115	0.306667	0.356	0.26
55-60	214	54	0.252336	0.316	0.196
50-55	168	14	0.083333	0.136	0.046
45-50	757	122	0.161162	0.189	0.136
40-45	1747	68	0.038924	0.049	0.03
35-40	1399	76	0.054325	0.068	0.04
30-35	802	28	0.034913	0.05	0.023
25-30	1147	9	0.007847	0.015	0.004
20-25	2642	7	0.00265	0.005	0.001
15-20	535	3	0.005607	0.017	0.001
10-15	827	9	0.010883	0.021	0.005

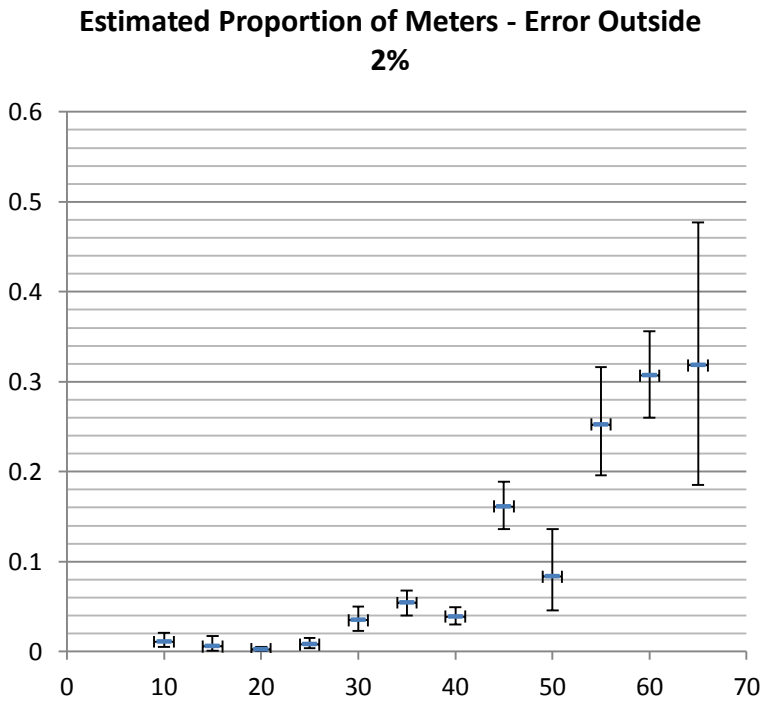

Figure 1 – Electro-Mechanical meters tend to have a higher proportion of in-service non-conforming meters over time

Figure 1 illustrates the data presented in Table 1. Looking at the confidence intervals for meters older than 35 years are likely to have more error-meters than is tolerable under the spirit of AS1284.13 and the overall installation error requirements according to the NER Chapter 7. These meters are predominantly jewel bearing meters in contrast to meters in

the 10-35 year age group. One exception are the meters falling in the 40-45 year age group where there is a weaker case for a population of error-meters with the confidence intervals lower estimate at 3%. Estimates either side of this group seem to indicate an expectation of a true higher proportion of error-meters indicating that this 40-45 year group should follow suit.

Table 2 – Installed meters to be replaced 2015-2020 because of unacceptable error proportion (accurate at 7/8/2014)

Age of Meters (Years)	Installed
65-70	6700
60-65	9517
55-60	2668
50-55	13 293
45-50	67 977
40-45	106 810
35-40	91 198
Total Needing Replacement	**298 163**

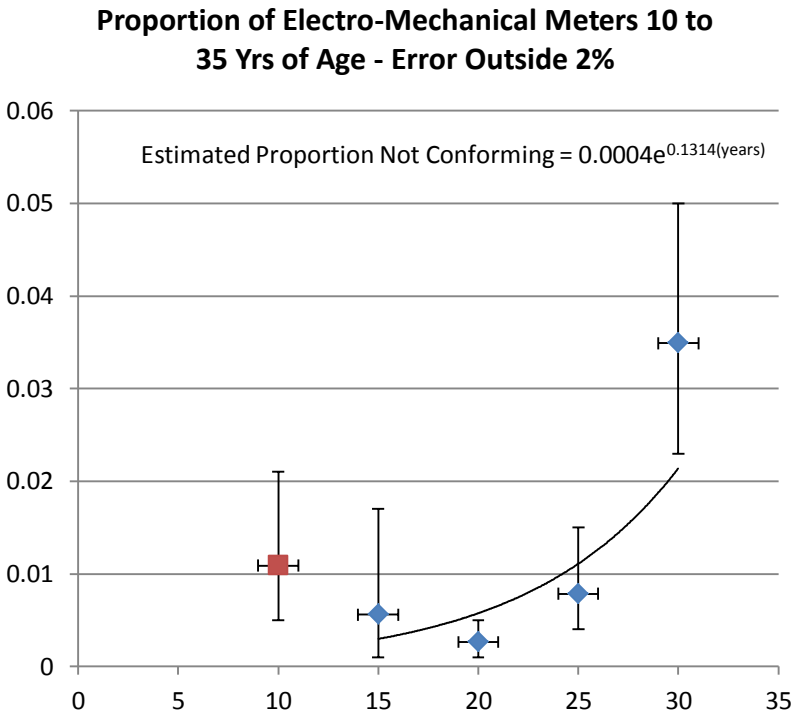

Figure 2 – Apart from our most recent Electro-Mechanical meters (10-15 years old), an exponential model appears to fit the conforming meter age groups

Figure 2 shows the Electro-Mechanical meters that have a tolerable number of error-meters (insufficient evidence to suggest otherwise). These meters fall within the 10 to 35 age

group. A line of best fit (Figure 2) follows an exponential model that seems to somewhat agree with the confidence intervals produced for the estimated proportion of error-meters.

If the model from Figure 2 fairly characterises the way the proportion of error-meters over time, then a meter population will have reached the acceptable number of error-meters once the population is 35 years old with a proportion of error-meters of p=0.0398. This seems to agree with the confidence intervals for meters aged over 35 years so far as their exceeding the tolerable limit for error-meters.

The meters in the age group of 10-15 were excluded from the model as the predicted proportions were unrealistic based on the data already collected. Further sampling under AS1284.13 will be used to monitor this age group. Additionally the model in Figure 2 should not be used to predict past the bounds of the data used.

Of the Electro-Mechanical meter populations that have a tolerable level of error-meters, according to the model in Figure 2, some meters will exceed the tolerable limits of error during the 2015 – 2020 regulatory period. These meter populations by age group are given in Table 3.

Table 3 – Meters expected to exceed tolerable limits and requiring replacement during 2015-2020

	Financial Year							Total
Age Group at Year	2014-2015	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	
	30	31	32	33	34	35		64 510
	31	32	33	34	35			21 518
	32	33	34	35				44 173
	33	34	35					37 919
	34	35						55 562
Total Number of Electro-Mechanical Meters to be Replaced According to the Model								**223 682**

The total number of replacements of Electro-Mechanical Meters is the sum of Tables 2 and 3.