215 South Cascade Street
PO Box 496
Fergus Falls, Minnesota 56538-0496
218 739-8200
www.otpco.com

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DEC 26 2013
NORTH DAKOTA
PUBLIC SERVICE COMMISSION

OTTER TAIL
POWER COMPANY

December 26, 2013

Darrell Nitschke
Director of Administration/Executive Secretary
North Dakota Public Service Commission
State Capitol
600 East Boulevard, Dept. 408
Bismarck, ND 58505-0408

RE: Otter Tail Power Company's 2013 Sample Meter Test Performance Report

Dear Mr. Nitschke:

Pursuant to North Dakota Rule 69-09-02-28(3), enclosed, as Attachment 1, are the results from the 2013 single-phase kWh sample meter test program for Otter Tail Power Company ("Otter Tail"). There were six groups of meters selected for the 2013 sample test. Criteria for selecting the groups were based on the time period the meters were purchased, manufacturer and model of meters. The meters were grouped as follows:

1. GE and SI meters purchased from 2003 to present.
2. GE meters purchased from 1969 to 2002.
3. SI meters purchased from 1969 to 2002.
4. L&G meters purchased from 1969 to 2002.
5. ABB model D4S meters purchased from 1975 to 1982.
6. GE model I50S meters.

Otter Tail's 2013 sample meter test indicates that the ABB model D4S meters purchased from 1975 to 1982 failed for the second time. Due to a miscommunication, the sample size was not increased for this group as stated in 2012. There are approximately 10,400 of these meters in service and will be removed within the next five years. The other groups passed the test and are performing satisfactorily.

In 2011, the ABB meters manufactured from 1969 to 1974 failed for the second time. These meters are being removed from service. All other groups of meters that have not passed the sample test in prior years have been removed from service.

1 PU-13-919 Filed: 12/26/2013 Pages: 8
2013 sample meter test performance report
Otter Tail Power Company
Anna Roberts

An electronic copy of this filing is being sent to you at dnitschk@nd.gov and to ndpsc@nd.gov. These items are filed for your information. If you have any questions, please contact me at (218) 739-8878 or aroberts@otpco.com.

Sincerely,

Anna Roberts

Anna Roberts
Load Researcher, Regulatory Administration

wao
Enclosures
By electronic filing

OTTER TAIL POWER CO.
SAMPLE METER TEST CALCULATION FORM
METERS IN SERVICE AT OTTER TAIL POWER CO.

12/19/2013

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #1 GE, I210 and SI, C1S meters purchased from 2003 to present**

LOT SIZE **29050** SAMPLE SIZE n= **120** AQL 2.5

FL BAR X **99.996** ***FL SIGMA*** **0.072**
LL BAR X **99.974** ***LL SIGMA*** **0.084**

ESTIMATE OF LOT ABOVE 102.0%

FL QU = $\frac{102 - FL\ BAR\ X}{FL\ SIGMA}$ $\frac{102 - 99.996}{0.072}$ = $\frac{2.004}{0.072}$ = **27.83**

Table B5 Calculations

QU=	27.83
n=	120
P=	**0**

LL QU = $\frac{102 - LL\ BAR\ X}{LL\ SIGMA}$ $\frac{102 - 99.974}{0.084}$ = $\frac{2.026}{0.084}$ = **24.12**

QU=	24.12
n=	120
P=	**0.00000**

From Table B-5 = **0.000** % PU FL above 102.0%
Calculations

0.000 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

FL QL = $\frac{FL\ BAR\ X - 98}{FL\ SIGMA}$ $\frac{99.996 - 98}{0.072}$ = $\frac{1.996}{0.072}$ = **27.72**

Table B5 Calculations

QL=	27.72
n=	120
P=	**0.00000**

LL QL = $\frac{LL\ BAR\ X - 98}{LL\ SIGMA}$ $\frac{99.974 - 98}{0.084}$ = $\frac{1.974}{0.084}$ = **23.50**

QL=	23.50
n=	120
P=	**0.00000**

From table B-5 = **0.000** % PL FL below 98.0 %
Calculations

0.000 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL 0.000 + 0.000 = **0.000**

Light Load P = PU LL + PL LL 0.000 + 0.000 = **0.000**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **4.69**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**)	99.996 + 0.288	UFL =	**100.284**
LFL = **FL *BAR X*** - (4 x **FL Sigma**)	99.996 - 0.288	LFL =	99.708
ULL = **LL *BAR X*** + (4 x **LL Sigma**)	99.974 + 0.336	ULL =	**100.310**
LLL = **LL *BAR X*** - (4 x **LL Sigma**)	99.974 - 0.336	LLL =	**99.638**

Lot is acceptable **x** Lot is unacceptable _____

Tested & Reported by: *Steve Ness* Approved: _____

OTTER TAIL POWER COMPANY

OTTER TAIL POWER CO.
SAMPLE METER TEST CALCULATION FORM
METERS IN SERVICE AT OTTER TAIL POWER CO.

12/19/2013

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #2 GE, I70S meters purchased from 1969 to 2002**

LOT SIZE **30904** SAMPLE SIZE n= **108** AQL 2.5

FL BAR X **99.937** ***FL SIGMA*** **0.409**

LL BAR X **99.587** ***LL SIGMA*** **0.511**

ESTIMATE OF LOT ABOVE 102.0%

FL QU = $\frac{102 - FL\ BAR\ X}{FL\ SIGMA}$ $\frac{102 - 99.937}{0.409}$ = $\frac{2.063}{0.409}$ = **5.04**

LL QU = $\frac{102 - LL\ BAR\ X}{LL\ SIGMA}$ $\frac{102 - 99.587}{0.511}$ = $\frac{2.413}{0.511}$ = **4.72**

Table B5 Calculations

QU=	5.04
n=	108
P=	**0.00000**

QU=	4.72
n=	108
P=	**0.00000**

From Table B-5 = Calculations **0.000** % PU FL above 102.0%

0.000 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

FL QL = $\frac{FL\ BAR\ X - 98}{FL\ SIGMA}$ $\frac{99.937 - 98}{0.409}$ = $\frac{1.937}{0.409}$ = **4.74**

LL QL = $\frac{LL\ BAR\ X - 98}{LL\ SIGMA}$ $\frac{99.587 - 98}{0.511}$ = $\frac{1.587}{0.511}$ = **3.11**

Table B5 Calculations

QL=	4.74
n=	108
P=	**0.00000**

QL=	3.11
n=	108
P=	**0.00076**

From table B-5 = Calculations **0.000** % PL FL below 98.0 %

0.076 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL 0.000 + 0.000 = **0.000**

Light Load P = PU LL + PL LL 0.000 + 0.076 = **0.076**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **4.69**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**) 99.937 + 1.636 UFL = **101.573**

LFL = **FL *BAR X*** - (4 x **FL Sigma**) 99.937 - 1.636 LFL = 98.301

ULL = **LL *BAR X*** + (4 x **LL Sigma**) 99.587 + 2.044 ULL = **101.631**

LLL = **LL *BAR X*** - (4 x **LL Sigma**) 99.587 - 2.044 LLL = **97.543**

Lot is acceptable **X** Lot is unacceptable

Tested & Reported by: *Steve Ness* Approved:

OTTER TAIL POWER COMPANY

OTTER TAIL POWER CO.

12/19/2013

SAMPLE METER TEST CALCULATION FORM

METERS IN SERVICE AT OTTER TAIL POWER CO.

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #3 SI, model C1S,J4S,J5S meters purchased from 1969 to 2002**

LOT SIZE **33296** SAMPLE SIZE n= **114** AQL 2.5

FL BAR X **99.930** ***FL SIGMA*** **0.368**

LL BAR X **99.820** ***LL SIGMA*** **0.571**

ESTIMATE OF LOT ABOVE 102.0%

Table B5 Calculations

FL QU = $\frac{102 - FL\ BAR\ X}{FL\ SIGMA}$ $\frac{102 - 99.93}{0.368}$ = $\frac{2.070}{0.368}$ = **5.62**

QU=	5.62
n=	114
P=	**0.00000**

LL QU = $\frac{102 - LL\ BAR\ X}{LL\ SIGMA}$ $\frac{102 - 99.82}{0.571}$ = $\frac{2.180}{0.571}$ = **3.82**

QU=	3.82
n=	114
P=	**0.00004**

From Table B-5 = **0.000** % PU FL above 102.0%

Calculations

0.004 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

Table B5 Calculations

FL QL = $\frac{FL\ BAR\ X - 98}{FL\ SIGMA}$ $\frac{99.93 - 98}{0.368}$ = $\frac{1.930}{0.368}$ = **5.24**

QL=	5.24
n=	114
P=	**0.00000**

LL QL = $\frac{LL\ BAR\ X - 98}{LL\ SIGMA}$ $\frac{99.82 - 98}{0.571}$ = $\frac{1.820}{0.571}$ = **3.19**

QL=	3.19
n=	114
P=	**0.00056**

From table B-5 = **0.000** % PL FL below 98.0 %

Calculations

0.056 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL 0.000 + 0.000 = **0.000**

Light Load P = PU LL + PL LL 0.004 + 0.056 = **0.061**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **4.69**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**)	99.930 + 1.472	UFL =	**101.402**
LFL = **FL *BAR X*** - (4 x **FL Sigma**)	99.930 - 1.472	LFL =	98.458
ULL = **LL *BAR X*** + (4 x **LL Sigma**)	99.820 + 2.284	ULL =	**102.104**
LLL = **LL *BAR X*** - (4 x **LL Sigma**)	99.820 - 2.284	LLL =	**97.536**

Lot is acceptable **x** Lot is unacceptable

Tested & Reported by: *Steve Ness* Approved:

OTTER TAIL POWER COMPANY

OTTER TAIL POWER CO.
SAMPLE METER TEST CALCULATION FORM
METERS IN SERVICE AT OTTER TAIL POWER CO.

12/19/2013

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #4 L&G, model MS,MX meters purchased from 1969 to 2002**

LOT SIZE	17847	SAMPLE SIZE n=	110	AQL	2.5
FL BAR X	100.021	***FL SIGMA***	0.274		
LL BAR X	99.721	***LL SIGMA***	0.931		

ESTIMATE OF LOT ABOVE 102.0%

FL QU = $\frac{102 - \textit{FL BAR X}}{\textit{FL SIGMA}}$ = $\frac{102 - 100.021}{0.274}$ = $\frac{1.979}{0.274}$ = **7.22**

Table B5 Calculations

QU=	7.22
n=	110
P=	**0.00000**

LL QU = $\frac{102 - \textit{LL BAR X}}{\textit{LL SIGMA}}$ = $\frac{102 - 99.721}{0.931}$ = $\frac{2.279}{0.931}$ = **2.45**

QU=	2.45
n=	110
P=	**0.00662**

From Table B-5 = **0.000** % PU FL above 102.0%
Calculations

0.662 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

FL QL = $\frac{\textit{FL BAR X} - 98}{\textit{FL SIGMA}}$ = $\frac{100.021 - 98}{0.274}$ = $\frac{2.021}{0.274}$ = **7.38**

Table B5 Calculations

QL=	7.38
n=	110
P=	**0.00000**

LL QL = $\frac{\textit{LL BAR X} - 98}{\textit{LL SIGMA}}$ = $\frac{99.721 - 98}{0.931}$ = $\frac{1.721}{0.931}$ = **1.85**

QL=	1.85
n=	110
P=	**0.03151**

From table B-5 = **0.000** % PL FL below 98.0 %
Calculations

3.151 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL	0.000	+	0.000	=	**0.000**
Light Load P = PU LL + PL LL	0.662	+	3.151	=	**3.813**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **4.69**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**)	100.021 + 1.096	UFL =	**101.117**
LFL = **FL *BAR X*** - (4 x **FL Sigma**)	100.021 - 1.096	LFL =	98.925
ULL = **LL *BAR X*** + (4 x **LL Sigma**)	99.721 + 3.724	ULL =	**103.445**
LLL = **LL *BAR X*** - (4 x **LL Sigma**)	99.721 - 3.724	LLL =	**95.997**

Lot is acceptable **X** Lot is unacceptable _____

Tested & Reported by: *Steve Nose* Approved: _____

OTTER TAIL POWER COMPANY

OTTER TAIL POWER CO.
SAMPLE METER TEST CALCULATION FORM
METERS IN SERVICE AT OTTER TAIL POWER CO.

12/19/2013

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #5 ABB, model D4S meters purchased from 1975 to 1982**

LOT SIZE **10587** SAMPLE SIZE n= **70** AQL 2.5

FL BAR X **99.886** ***FL SIGMA*** **0.530**

LL BAR X **98.940** ***LL SIGMA*** **3.228**

ESTIMATE OF LOT ABOVE 102.0%

FL QU = $\frac{102 - FL\ BAR\ X}{FL\ SIGMA}$ $\frac{102 - 99.886}{0.53}$ = $\frac{2.114}{0.530}$ = **3.99**

Table B5 Calculations

QU=	3.99
n=	70
P=	**0.00001**

LL QU = $\frac{102 - LL\ BAR\ X}{LL\ SIGMA}$ $\frac{102 - 98.94}{3.228}$ = $\frac{3.060}{3.228}$ = **0.95**

QU=	0.95
n=	70
P=	**0.17169**

From Table B-5 = **0.001** % PU FL above 102.0%
Calculations

17.169 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

FL QL = $\frac{FL\ BAR\ X - 98}{FL\ SIGMA}$ $\frac{99.886 - 98}{0.53}$ = $\frac{1.886}{0.530}$ = **3.56**

Table B5 Calculations

QL=	3.56
n=	70
P=	**0.00010**

LL QL = $\frac{LL\ BAR\ X - 98}{LL\ SIGMA}$ $\frac{98.94 - 98}{3.228}$ = $\frac{0.940}{3.228}$ = **0.29**

QL=	0.29
n=	70
P=	**0.38583**

From table B-5 = **0.010** % PL FL below 98.0 %
Calculations

38.583 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL 0.001 + 0.010 = **0.011**

Light Load P = PU LL + PL LL 17.169 + 38.583 = **55.752**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **4.87**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**) 99.886 + 2.12 UFL = **102.006**

LFL = **FL *BAR X*** - (4 x **FL Sigma**) 99.886 - 2.12 LFL = 97.766

ULL = **LL *BAR X*** + (4 x **LL Sigma**) 98.940 + 12.912 ULL = **111.852**

LLL = **LL *BAR X*** - (4 x **LL Sigma**) 98.940 - 12.912 LLL = **86.028**

Lot is acceptable _____ Lot is unacceptable x

Tested & Reported by: *Steve Nose* Approved: _____

OTTER TAIL POWER CO.
SAMPLE METER TEST CALCULATION FORM
METERS IN SERVICE AT OTTER TAIL POWER CO.

REFERENCE - TABLES A-2, B-3, B-4, B-5, AND EXAMPLE B-3 OF MIL-STD-414.

TYPE OF METERS IN THIS SAMPLE: **2013 Sample #6 GE, model I50S meters**

LOT SIZE **3585** SAMPLE SIZE n= **114** AQL 2.5

FL BAR X **100.071** ***FL SIGMA*** **0.250**
LL BAR X **99.994** ***LL SIGMA*** **0.547**

ESTIMATE OF LOT ABOVE 102.0%

$$FL\ QU = \frac{102 - FL\ BAR\ X}{FL\ SIGMA} = \frac{102 - 100.071}{0.25} = \frac{1.929}{0.250} = \mathbf{7.72}$$

$$LL\ QU = \frac{102 - LL\ BAR\ X}{LL\ SIGMA} = \frac{102 - 99.994}{0.547} = \frac{2.006}{0.547} = \mathbf{3.67}$$

Table B5 Calculations

QU=	7.72
n=	114
P=	**0.00000**

QU=	3.67
n=	114
P=	**0.00008**

From Table B-5 = **0.000** % PU FL above 102.0%
Calculations

0.008 % PU LL above 102.0 %

ESTIMATE OF LOT BELOW 98.0%

$$FL\ QL = \frac{FL\ BAR\ X - 98}{FL\ SIGMA} = \frac{100.071 - 98}{0.25} = \frac{2.071}{0.250} = \mathbf{8.28}$$

$$LL\ QL = \frac{LL\ BAR\ X - 98}{LL\ SIGMA} = \frac{99.994 - 98}{0.547} = \frac{1.994}{0.547} = \mathbf{3.65}$$

Table B5 Calculations

QL=	8.28
n=	114
P=	**0.00000**

QL=	3.65
n=	114
P=	**0.00009**

From table B-5 = **0.000** % PL FL below 98.0 %
Calculations

0.009 % PL LL below 98.0 %

TOTAL PERCENT DEFECTIVE

Full Load P = PU FL + PL FL: 0.000 + 0.000 = **0.000**

Light Load P = PU LL + PL LL: 0.008 + 0.009 = **0.017**

ALLOWABLE PERCENT DEFECTIVE: TABLE B-3 **5.2**

OUTLIERS

UFL = **FL *BAR X*** + (4 x **FL Sigma**) 100.071 + 1 UFL = **101.071**
LFL = **FL *BAR X*** - (4 x **FL Sigma**) 100.071 - 1 LFL = 99.071

ULL = **LL *BAR X*** + (4 x **LL Sigma**) 99.994 + 2.188 ULL = **102.182**
LLL = **LL *BAR X*** - (4 x **LL Sigma**) 99.994 - 2.188 LLL = **97.806**

Lot is acceptable **x** Lot is unacceptable

Tested & Reported by: *Steve Ness* Approved: