



Portland General Electric
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September 29, 2023

Public Utility Commission of Oregon
Attn: Filing Center
201 High Street, S.E.
P.O. Box 1088
Salem, OR 97308-1088

RE: UM 1384 PGE's Revision to Meter Test and Inspection Policy

Portland General Electric Company (PGE) hereby submits for Commission approval, PGE's revised Meter Test and Inspection Policy. The Meter Test and Inspection Policy are used as minimum legal standards for metering system compliance under the following authorities: Oregon Revised Statute (ORS) 757.250, Oregon Administrative Rule (OAR) 860-023-0015, and ANSI C12.1-2022 Code for Electricity Metering.

The proposed revisions to PGE's Meter Test and Inspection Policy align with industry practices and standards. Industry standards, such as updates made in ANSI C12.1-2022 Section 5.0.3.3, have adopted the use of meter data analytics from AMI systems to better identify meter anomalies and improve overall meter system health. PGE will be leveraging the data analytics program outlined in this policy while aligning with ANSI C12.1-2022 to proactively identify meter anomalies and service issues in a more accurate and efficient manner compared to random sample testing of in-service meters.

PGE is including the following attachments:

Attachment A - Summary of the proposed changes within each section of the policy.

Attachment B - PGE's Meter Test and Inspection Policy.

Attachment C - PGE's Meter Analytics Plan, outlines the procedures for validation and remediation of in-service meters.

Attachment D - A redline version of PGE's Meter Test and Inspection Policy.

PGE requests that this Policy be approved at an upcoming public meeting with an effective date of January 1, 2024.

Should you have any questions or comments regarding this filing, please contact Mary Widman at mary.widman@pgn.com

Please direct all formal correspondence and requests to the following email address
pge.opuc.filings@pgn.com

Sincerely,

\s\ Robert Macfarlane

Robert Macfarlane
Manager, Pricing & Tariffs

Enclosures

UM 1384
PGE's Revision to Meter Test and Inspection Policy

Attachment A



Summary

The proposed revisions are made to Portland General Electric (PGE) meter test and inspection policy to align with industry practices and standards.

Industry standards, such as updates made in ANSI C12.1-2022 Section 5.0.3.3, have adopted the use of meter data analytics from AMI systems to better identify meter anomalies and improve overall meter system health. PGE will be leveraging the data analytics program outlined in this policy while aligning with ANSI C12.1-2022 to proactively identify meter anomalies and service issues in a more accurate and efficient manner compared to random sample testing of in-service meters.

A summary of proposed changes within each section of the policy is provided below.

Section 1 - Scope

No change.

Section 2 – General

No change.

Section 3 – References

Industry standards updated with latest applicable revision dates.

Section 4 – Definitions

No change.

Section 5 – Watt-hour Standards and Standardizing Equipment

Industry standards updated with latest applicable revision dates.

Section 6 – Meter Quality Assurance

Industry standards updated with latest applicable revision dates and applicable sections.

Clarified Company accuracy registration tolerances.

Section 7 – In-Service Random Sample Meter Testing

Industry standards updated with latest applicable revision dates.

Added meter testing method for Company analytics plan as described in ANSI C12.1-2022 Section 5.0.3.3. Meters covered by Company analytics plan will actively communicate with Company AMI network and be monitored for performance aberrations.

Updated random sample meter testing method for meters outside of Company analytics plan. Meters that do not actively communicate with Company AMI network will be covered under random sample testing method.



Updated general inspection level allowance based on Company discretion if random sample group has met requirements described in ANSI/ASQ Z1.9-2003(R2013) Section A10.

Updated tests results analysis based on testing method to meet requirements described in ANSI C12.1-2022 Section 5.0.3.3.

Section 8 – In-Service Periodic Meter Testing

Industry standards updated with latest applicable revision dates and applicable sections.

Section 9 – Instrument Transformers

Industry standards updated with latest applicable revision dates.

Removed heading language for consistency.

Section 10 – Testing and Verification Methods

Industry standards updated with latest applicable revision dates and applicable sections.

Section 11 – Security and Revenue Protection

Updated language referencing Company.

Section 12 – Electric Service Requirements

Updated website URL found to be capitalization sensitive dependent on browser.

Section 13 – Record Keeping

Updated formatting.

Section 14 – Meter Tests Requested by Customers

No change.

Section 15 – Treatment of Inaccurate Metering Data

Updated language referencing Commission.

Section 16 – Annual Metering Management Review

Updated language referencing Company.

Section 17 – Annual Report and Certification to OPUC

Updated language referencing Company and Commission.

UM 1384
PGE's Revision to Meter Test and Inspection Policy

Attachment B

PORTLAND GENERAL ELECTRIC METER TEST AND INSPECTION POLICY

PROCEDURES FOR MAINTAINING THE ACCURACY OF PORTLAND GENERAL ELECTRIC STANDARDS, METERS, AND METERING SYSTEMS

**Previous Revision – April 22, 2020
Revision – January 1, 2024**

1. Scope

This document outlines the procedural requirements of Portland General Electric's (PGE or Company) scheduled electric metering test and verification programs. This policy is submitted to satisfy OAR 860-023-0015 as required by the Oregon Public Utility Commission (OPUC or Commission).

PGE deployment of solid-state Advanced Metering Infrastructure (AMI) meters occurred between 2008 and 2010 to replace in-service electromechanical meters. AMI meters allow for automated collection of meter data through a fixed two-way communication network. Adjustments to policy were made post-deployment for increased monitoring and verification purposes to ensure meter accuracies remained within acceptable tolerances.

This policy revision aligns with current industry testing methods and practices while ensuring system validation through statistical analysis.

2. General

The intent of PGE's metering policies, procedures, and practices is to properly apply, install and maintain meters and metering devices to ensure the accuracy of customer metering. No meter or metering device shall be placed in service, or allowed to remain in service, that has an incorrect watt-hour constant, that is mechanically or electrically defective, incorrectly connected, installed, or applied, or that is outside acceptable accuracy tolerances. No device shall be placed on or in a meter or metering system that could adversely affect the accuracy or performance of the meter or metering system.

PGE standards, practices and procedures for maintaining the accuracy of electric meters and metering systems are based on accepted national metering and quality standards and are maintained in compliance with applicable regulatory requirements and rules.

PGE has established practices and programs for continuing surveillance of its metering systems and customer service facilities to determine and take appropriate action

concerning hazards, failures and defects associated with metering systems and customer service facilities.

All PGE employees and contractors who perform work associated with customer metering systems shall be trained and be alert in the normal course of their daily work to identify and report safety, security, revenue and other metering defect issues.

3. References

This document references the following industry and PGE standards:

- PGE Meter Operations shall communicate and implement metering policies, standards and procedures internal to the company and to applicable contractors.
- ORS 757.250 and OAR 860-023-0015 shall be used as minimum legal standards for metering system compliance.
- ANSI C12.1-2022 Code for Electricity Metering shall be used as a minimum maintenance standard for accuracy performance for standardizing equipment and in-service tests and metering devices.
- ANSI/ASQ Z1.4-2003 (R2013) Sampling Procedures and Tables for Inspection by Attributes shall be used as a minimum for meter acceptance testing.
- ANSI/ASQ Z1.9-2003 (R2013) Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming shall be used as a minimum standard for in-service meter sample testing.
- PGE Electric Service Requirements is used as standard for new metering and service installations.
- Public Utility Commission of Oregon Order No. 08-245 in UE 189.

4. Definitions

- (a) AMI Meter – a solid-state electronic meter which provides for two-way communications to allow the automated collection of metering data and for sending signals to the meter.
- (b) Company – Portland General Electric
- (c) Defective Meter Group – An identified homogeneous group of meters, or distinct subdivision thereof, that exceeds acceptable percent nonconforming, as defined in ANSI/ASQ Z1.9-2003 (R2013).
- (d) Homogeneous Meter Group (HMG) – A group of meters produced by the same manufacturer, having related type designation, of the same design and the same relationship of parts.
- (e) Metering System – The entire metering circuit and installation including all sensing, measuring, totalizing, registering and communication devices as well as enclosures, instrument transformers, wiring and communication links.
- (f) NIST – National Institute of Standards and Technology, under US Dept. of Commerce.
- (g) Periodic Meter Group (PMG) – A group of metering systems tested, inspected, and verified in a specific year that are on the same test frequency in a Periodic Meter Test Program.

- (h) Periodic Meter Test Program – An established scheduled pattern of meter testing and site verification where each site will be selected according to a designated regular time-interval.
- (i) Sample Meter Test Program – An established random pattern of testing meters belonging to a HMG whereby each meter has an equal opportunity to be selected for testing each year.
- (j) Uniquely Defective Meter – A meter selected for random sampling with unusable test results, including meters with broken covers, missing test data, accuracy performance characteristics greater than $\pm 5\%$ resulting from unique physical experience or unique electrical experience, and is not representative of other in-service meters in its HMG.

5. Watt-hour Standards and Standardizing Equipment

- (a) PURPOSE:
To ensure watt-hour measurement equipment used to test accuracy of billing meters is calibrated and traceable to National Institute of Standards Technology (NIST).
- (b) RESPONSIBILITY:
The company maintains a Standards Laboratory that is responsible for certification of all portable watt-hour standards used within PGE. The Standard Laboratory is available at all times, by appointment, during business hours for inspection or use by Commission's representatives.
- (c) SUMMARY OF METHOD:
The company uses a reference watt-hour standard to compare all other watt-hour standards to ensure revenue meter accuracy. The calibration accuracy of the reference standard is verified at six-month intervals to Standard Instruments and are traceable to NIST. If the accuracy of the reference standard is outside acceptable tolerances as defined by ANSI C12.1-2022 Section 3, the Company shall calibrate the standard to acceptable limits, if possible. The reference watt-hour standard is stored and used in a temperature and humidity-controlled environment.

The reference watt-hour standard is used to certify portable watt-hour standards at intervals not to exceed six-months. Certifications are performed by the Company Instrument Laboratory using a comparison method with a secondary watt-hour standard.

Documentation for all calibrations and for calibration procedures and results for each reference standard, portable watt-hour standard, and portable secondary watt-hour standard is maintained in a database system and should be kept for at least five years. A calibrated certification tag is affixed to each watt-hour standard. Each certification tag contains the calibration date, calibration result, next calibration due date, and the calibrating technician initials. Calibrations are performed following the guidance of ANSI C12.1-2022, ANSI code for Electric Metering.

6. Meter Quality Assurance

(a) PURPOSE:

To assure meters meet Company accuracy requirements before acceptance or installation in accordance with ANSI C12.1-2022.

(b) RESPONSIBILITY:

The meter manufacturer shall test all new single-phase and three-phase meters before being shipped to the company. The manufacturer shall provide certified test data for all new meters to the company. The Company is responsible for analysis of meter manufacturers test data to ensure accuracy specifications are met. The Company shall provide copies of its analysis of the manufacturers test data to the Commission in its next Annual Certification Report. If the Company purchased used solid-state meters, the Company is responsible for testing all the purchased meters. The Company is responsible for keeping meter test records in accordance with Section 13 of this policy.

(c) SAMPLING METHOD:

Sample testing of new meters is accomplished by selecting samples based on shipment size as defined in ANSI/ASQ Z1.4-2003 (R2013) with a General Inspection Level II, Acceptance Quality Limit (AQL) of 2.5, and Double Sampling Plan. Accuracy testing is performed based on ANSI C12.1-2022 Section 4.7.2, Company accuracy tolerance specifications, and includes functionality testing of communication modules. If number of failed accuracy tests is less than limit defined in ANSI/ASQ Z1.4-2003 (R2013), shipment is accepted.

The Company requires percent registration within $100 \% \pm 0.3 \%$ for new meters at light and full loads for solid-state electronic meters. Any sample test lot found to be outside acceptable accuracy limits would be held from service until repaired or replaced. Weighted percent registration is defined by ANSI C12.1-2022, Section 5.1.4.1 Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters.

(d) Meter Manufacturer Assessment

The Company will perform a quality assessment on each watt-hour meter supplier at intervals not to exceed five years.

7. In-Service Random Sample Meter Testing

(a) PURPOSE:

The purpose of this test program is to detect inaccurate meter groups and yield statistical information on which to base future maintenance and testing.

The in-service testing program includes watt-hour meters of the following types:

- Self-contained single-phase and three-phase revenue meters.
- Instrument transformer rated revenue meters.

(b) RESPONSIBILITY:

The Company shall report on the results of its in-service random sample meter testing in its Annual Certification Report. The Company is responsible for keeping these results for at least ten years.

(c) METHOD:

(1) Meters that communicate with Company AMI network will receive testing and inspection when identified with performance aberrations monitored on an ongoing basis as defined by Company analytics plan based on ANSI C12.1-2022, Section 5.0.3.3.

(2) Meters that do not communicate with Company AMI network will receive annual random sample testing and inspection. Random sample of meters are selected annually from each applicable Homogeneous Meter Group (HMG) using the company meter asset database and placed into sample lots. Sample lots are created and tested in the following manner:

Meters are grouped by equipment type, manufacturer, and model having the same design and relationship of parts. For large HMGs over 150,000 meters, subgroups no larger than 100,000 meters are created.

Group sample sizes are based on ANSI/ASQ Z1.9-2003 (R2013) with a General Inspection Level I or II, Acceptance Quality Limit (AQL) of 2.5, and Double Specification Limit. General Inspection Level shall be Inspection Level II by default and may be specified at Inspection Level I if group has met switching procedure requirements defined by ANSI/ASQ Z1.9-2003 (R2013), Section A10. Maximum Allowable Percent Defective for each meter sample lot is determined from ANSI/ASQ Z1.9, Table B-3 Inspection Level II or Table B-4 Inspection Level I.

(3) The test results of uniquely defective meters are excluded from statistical analysis only if the cause of the error can be attributed to external causes or outside forces (e.g., vandalism, tampering, lightning, corrosive environment, etc.).

(d) TEST RESULTS ANALYSIS:

- (1) Test results for method outlined in 7(c)(1) are analyzed based on the Company analytics plan and shall include accuracy tests of meters not identified or suspected for any known defect to safeguard against new or unstudied defects and accuracy errors and those undetectable by remote means.
- (2) Random sample plan test results for method outlined in 7(c)(2) are analyzed based on ANSI/ASQ Z1.9-2003 (R2013). If Estimated Lot Percent Defective exceeds Maximum Allowable Percent Defective for two consecutive years the lot is considered to be a "failed" lot. Meters within a failed lot will be retired within four years.

The Company shall evaluate uniquely defective meters identified within each HMG. Condition codes are assigned to uniquely defective meters based on initial condition of meter installation.

8. In-Service Periodic Meter Testing

(a) PURPOSE:

The purpose of this testing and verification program is to identify and correct inaccurate and defective metering systems. Additionally, this program is to detect inaccurate meter groups and yield statistical information on which to base future maintenance and testing.

This in-service program includes revenue meters that are for services with an average load 1MW and greater.

(b) RESPONSIBILITY:

The Company shall provide the results of its in-service periodic meter testing in its Annual Certification Report. The Company is responsible for keeping these results for at least ten years.

(c) METHOD:

Large Commercial/Industrial customers served by substation metering will receive biennial meter testing and inspection. Commercial/Industrial customers that have an average load greater than 1MW will receive biennial meter testing and inspection. Meter lots will be divided into groups based on Company equipment type and manufacturer.

A meter is defined as acceptable if as-found average accuracy is within 100 ± 0.3 percent registration. Weighted percent registration is defined by ANSI C12.1-2022, Section 5.1.4.1 Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters.

All meters with an error greater than ± 0.3 % in as-found testing are removed from service. All meters with an error greater than + 5 % in as-found testing are declared

uniquely defective and removed from service. The test results of uniquely defective meters are excluded from statistical analysis only if the cause of error is attributed to external causes or outside forces (e.g., vandalism, tampering, lightning, corrosive environment, etc.).

9. Instrument Transformers

(a) PURPOSE:

To ensure that metering transformers are accurate in accordance to ANSI C12.1-2022 and IEEE C57.13-2016.

(b) RESPONSIBILITY:

The Company is responsible for ensuring current and voltage transformers used for revenue metering are accurate and within acceptable accuracy tolerance limits. The Company is responsible to validate manufacturer test results.

(c) METHOD:

The Company requires all metering current and voltage transformers be tested by the manufacturer. The manufacturer will provide the company with certified test results that verify voltage withstand, ratio correction factor, and phase angle tests were performed. All current and voltage transformers utilized for revenue metering will have an in-service test and validation performed within 90 days of installation.

(d) TESTING:

Pre-installation tests are performed by the manufacturer in accordance with ANSI C12.1-2022 section 5.2.1. Metering current and voltage transformers are rated at 0.3 % accuracy or better.

Field Testing/Verification complies with ANSI C12.1-2022 Section 5.2.3 and Section 5.2.4. All instrument transformers, both new and returned from service, will have a field test/verification performed within 90 days of installation. The following tests/verifications are performed after meter installation is in-service:

- ANSI C12.1-2022: 5.2.3.1---Burden Test
- ANSI C12.1-2022: 5.2.3.2---Secondary Voltage Test
- ANSI C12.1-2022: 5.2.4-----Inspection

(e) Instrument Transformer Manufacturer Assessment

The Company will perform a quality assessment on each instrument transformer supplier at intervals not to exceed five years.

10. Testing and Verification Methods

(a) RESPONSIBILITY:

The Company is responsible for operating, maintaining, and revising metering test and verification program. Tests and verifications are performed by the Company or approved contractor for the Company.

(b) TESTING:

Watt-hour tests are performed at 100 percent of nameplate test current (FL) and 10 percent of nameplate test current (LL) in accordance with ANSI C12.1-2022.

A meter is defined as acceptable if as-found average accuracy is within 100 ± 0.3 percent registration. Weighted percent registration is defined by ANSI C12.1-2022, Section 5.1.4.1 Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters.

(c) CALIBRATION:

Electronic meters are not calibrated.

(d) VERIFICATION OF METERING SYSTEMS:

Meter system verifications are performed on all metering installations when tested; this includes periodic and sample tests along with new, transformer service installations 90 days after the service was energized. The purpose of the verification is to assure the correctness of the meter installation and associated records, it will include the following when applicable:

- A. Meter accuracy testing
- B. Demand register testing
- C. Correctness of meter application
- D. Meter loading
- E. Correctness of billing multiplier
- F. Correctness of wiring
- G. Condition of wiring
- H. Current transformer sizing
- I. Quality and ratio of instrument transformers (verify nameplate data)
- J. Current transformer burden tests
- K. Voltage measurements
- L. Current measurements
- M. Phase angle test
- N. Instantaneous power factor measurements
- O. Security of the metering system and components
- P. Accessibility of the meter and other metering devices
- Q. Safety of the metering system and site
- R. Safety and condition of the electric distribution system
- S. Current diversion
- T. Revenue implications (i.e., customer under-billing or over-billing)

11. Security and Revenue Protection

The Company will maintain documented procedures to ensure and verify the physical security and safety of metering installations through training of personal, control of sealing and locking devices, and installation of seals and locking devices for meter system security and integrity. Additional controls will be used for meter information technology security. Password protections will be maintained for programmable meters to prevent unauthorized adjustment, programming or data acquisition.

Revenue validation and protection programs will include training of field and billing personnel and high/low energy usage audits designed to trigger consumption investigations. Qualified personnel are assigned the responsibility to investigate field conditions that may have loss of revenue implications.

12. Electric Service Requirements

Specific applications of the Electric Utility Service Equipment Requirements Committee (EUSERC) manual are described in the company Electric Service Requirements, available at: PortlandGeneral.com/esr.

13. Record Keeping

Records are maintained for all laboratory and field test standards by serial number. Records for standards are maintained for the life of the equipment plus five years. Test records are maintained for all meters and auxiliary transformers for the life of the equipment plus one year. All energy diversion investigations are recorded and records are maintained for five years.

The record of the most recent accuracy test of each instrument transformer is maintained for at least as long as the instrument transformer is in service plus three years. The record of each instrument transformers includes the manufacturer's name or trademark, type, and serial number. Each instrument transformer placed in service will be marked with the same information.

The record of the most recent accuracy test of each watt-hour meter is maintained for at least as long as the instrument transformer is in service plus three years. Accuracy record of each watt-hour meter includes the following:

- A. Date of test;
- B. Reason for test;
- C. Reading and accuracy of meter as found and as left;
- D. Identification of person who performed the test; and
- E. Identification of equipment used to test meter.

The record of each watt-hour meter includes the following:

- F. Manufacturer and date of purchase, along with any testing data provided by the manufacturer that is used by the entity for acceptance testing of the meter;
- G. Manufacturer or Company's identification number;
- H. Date and place of present or most recent installation
- I. Date and type of last major repair, or of final disposition;
- J. Nameplate data, which includes:
 - i. Form designation or circuit description;
 - ii. "Watt-hour meter" or other description;
 - iii. Manufacturer's name or trademark;
 - iv. Manufacturer's type;
 - v. Electrical current class;
 - vi. Rated voltage;
 - vii. Number of wires;
 - viii. Frequency;
 - ix. Test amperes;
 - x. Watt-hour meter constant; and
 - xi. Watt-hour meter test constant (if applicable).

14. Meter Tests Requested by Customers

If a customer requested that a meter that serves their account be tested for accuracy, the Company shall test the customer's meter, in accordance with OAR 860-021-0130.

15. Treatment of Inaccurate Metering Data

Upon discovery that a meter serving a customer is outside acceptable Commission limits as defined in OAR 860-021-0130, the Company shall correct the metering error. The Company shall direct its billing department to adjust customer bills according to the corrected metering data and reimburse customer for all overcharges as defined in OAR 860-021-0135.

16. Annual Metering Management Review

The Company will annually evaluate the currency of its metering policies, practices and procedures with updated national and state regulations, standards and guidelines. PGE will maintain a documented management review program to ensure compliance with OPUC regulations and established company policies and directives.

17. Annual Report and Certification to OPUC

The Company will submit an annual certification report to the Commission as set out in Section S of the Commission's Electric utility Metering Policy. Included in the report are:

- A. Company's analysis of newly purchased watt-hour meter accuracy tests provided by the manufacturers

- B. Meter group descriptions
- C. Number of meters in the group
- D. Number of meters tested per group
- E. Mean of the as-found Average Accuracy for each group
- F. Standard deviation of the as-found Average Accuracy for each group
- G. High/low range of the as-found Average Accuracy for each group
- H. Percentage above/below 100 + 2 % Average Accuracy for each group
- I. Number of meters uniquely defective per HMG group listed by cause and analysis of defects
- J. Company's analysis of in-service periodic meter testing
- K. Proposed action for future testing and maintenance based on test results
- L. Meter Audit failures listed by cause and analysis of defects for PMG's
- M. Nonconformance Revenue Implications
- N. The number of qualified personnel employed by the Company
- O. Executive Summary of Annual Metering Management Review

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PGE's Revision to Meter Test and Inspection Policy

Attachment C

Portland General Electric

Meter Analytics Plan

Procedures for Validation and Remediation of In-Service Meters

Effective Date: January 1, 2024



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Scope

This document outlines PGE's Meter Analytics Plan for in-service meters to maintain metering devices in an acceptable degree of accuracy and performance throughout their service life. This plan outlines validation and remediation processes of in-service meters using AMI meter data and analytics methodologies to identify meter performance aberrations.

The Meter Analytics Plan will apply to the following meters:

- Meters with functional AMI communicating modules.

The Meter Analytics Plan will not apply to the following meters and will be tested by one of the following methods:

- Random sample testing
 - Meters with non-functional AMI communicating modules.
 - Meters designated opt-out.
- Periodic testing
 - Commercial/Industrial customers with an average load greater than 1 MW
 - Large Commercial/Industrial customers served by substation metering

Background and Current State

Industry standards, such as updates made in ANSI C12.1-2022 Section 5.0.3.3, have adopted the use of meter data analytics from AMI systems to better identify meter anomalies and improve overall meter system health. PGE will be leveraging the data analytics program outlined in this policy while aligning with ANSI C12.1-2022 to proactively identify meter anomalies and service issues in a more accurate and efficient manner compared to random sample testing of in-service meters.

Currently, random samples of meters are selected annually from each applicable Homogeneous Meter Group (HMG) to test in-service meters. The HMG grouping is based on equipment type, manufacturer, and model having the same design and relationship of parts. Meter sample groups are created annually and field testing is scheduled through the calendar year.

In the preceding five years (2017 to 2022), 20,346 meters out of 20,361 meters tested through the random sampling method were identified to be within OPUC acceptable accuracy tolerance limits of $100 \pm 2\%$. This indicates greater than 99.92% of meters tested by random sampling were found to be within acceptable accuracy tolerances.

In the same timeframe (2017 to 2022), there were 168 meters identified outside acceptable accuracy tolerance limits through non-sample testing work orders. Non-sample testing work order types include customer high-bill complaints, customer power quality complaints, suspicion of tampering, new meter installations, internal referrals from a PGE employee for a meterman to investigate site further, and/or meter refurbishment.

Random sample testing limitations

Meters selected for random sample testing are based on in-service status at the beginning of a given calendar year. On-site testing is performed throughout the year (Jan. 1 to Dec. 31) by field personnel. The random nature of site visits creates limitations in identifying temporary or self-healing issues that seldom occur with a meter while field personnel are present due to self-clearing functionality of AMI meters and may result in repeat site visits when troubleshooting issues.

Other examples of limitations with random sampling testing include:

- **No ongoing anomaly detection:** The duration from the time a meter could have gone defective to the time it is identified and remediated reactively from a customer call or from a random sampling testing results in a poor customer experience without a continuous ongoing anomaly detection.
- **Inefficient use of field resources:** A meter could have been removed or exchanged by the time a site is visited for random sampling resulting in a wasted trip to the site. Additionally, multiple field visits to the same premise could occur if a site is visited for testing and the meter exhibits service or metrology issues at a later date.

Goals and Objectives

The goal is to leverage data and analytics to identify meter anomalies and schedule targeted field visits to validate and remediate the anomalies proactively towards the following objectives.

Ongoing anomaly detection

With data and analytics, identify meter anomalies on an ongoing basis throughout the year across the entire PGE service territory to be able to identify probable meter anomalies and schedule targeted field visits to remediate them proactively. This will result in a better customer experience being able to identify issues as early as possible.

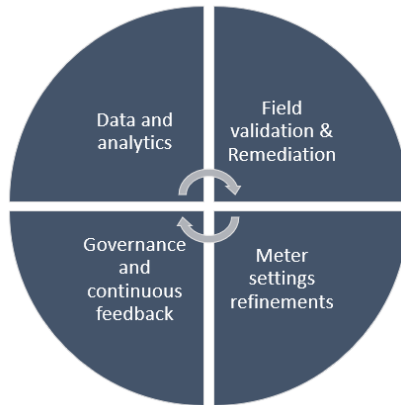
Efficient use of field resources

With targeted field visits based on the anomalies detected based on data and analytics results in more efficient use of field resources.

Plan Description

The pillars of the plan are:

- a) Ongoing meter anomalies detection with data and analytics
- b) Field validation and remediation
- c) Meter settings refinements
- d) Governance and continuous feedback



Ongoing meter anomalies detection with data and analytics

There are several aspects of the meter data that are brought to a central cloud data lake including manufacturer, form attributes, alarms/ events, and voltage data. Analytics are run against this data across all the AMI communicating meters in the PGE service territory in an ongoing basis to identify meter anomalies including the following:

- Inactive phase
- Voltage Fluctuations
- Meter Alarms

PGE has created a new policy for metermen to perform an accuracy test whenever there is a scenario to remove a meter from the socket. This new policy supplements existing sample testing policies. The new policy can be found in Appendix A.

Field validation and remediation

Meter anomalies identified with data and analytics are reviewed and work orders are created to remediate in the field in a timely fashion.

Meter settings refinements

Meter settings are reviewed and refined to make sure they can collect data and generate alarms when values are over or under the thresholds. One example is setting the right voltage thresholds for the

meter voltages based on ANSI standards so that alarms are generated when the voltage is above or below the thresholds.

Governance and continuous feedback

As part of the plan, there will be governance, continuous feedback, and improvements across all the pillars of the plan.

- With the proposed addition of policy to perform an accuracy test for any scenario where a meterman has to remove the meter from the socket, the results of this accuracy test will be used as a feedback loop to the data and analytics to improve the detection of the future anomalies.
- Meter settings refinements will help with more accurate alarms/event data from the meters resulting in better data quality for the analytics to predict meter anomalies.

Implementation Timeline

- **Year 2023** is the pilot year where meter and service anomalies have been identified with data and analytics and remediated in the field.
 - From April to September of this year, around 900,000 communicating meters have been reviewed with data and analytics in an ongoing basis.
 - Approximately 820 meter or service anomalies have been identified thus far.
 - There is currently a 98 percent success rate for field visits on identified anomalies.
 - **Two safety situations with a wire down were found using this proactive approach.**
- **Year 2024** will be the baseline year for the rollout of the analytics plan.
 - There will be continuous improvements incorporated into the plan based on the outcomes and knowledge gained throughout the year.
- **Year 2025** will be the operational year that includes governance and continuous feedback to incorporate learned outcomes and results.

Appendix A

Portland General Electric Meter Test Policy for Field Operations



Meter Test Policy for Field Operations

Meter Operations Policy

IMPORTANT: *Do not use this document until you verify that it's the version with the most recent date.*

Policy

Journeyman who removes a meter from the meter base/socket for power quality, suspected meter/billing accuracy, or maintenance related work activities are required to perform an accuracy test on the meter prior to reinstallation. This policy aims to ensure the safety, functionality, and proper documentation of equipment used during field operations.

Scope

This policy applies to all journeyman who engage in tasks that necessitate the removal of electrical meters from its base, irrespective of their job position or department.

Equipment Testing Requirements

Pre-Removal Testing

Prior to removing a meter from its base, employees must conduct a thorough pre-removal testing process. This includes verifying that the equipment is functioning correctly, identifying any pre-existing issues, and confirming that the equipment is safe to remove.

Replaced meter testing

In situations where the original meter is not reinstalled and is instead replaced with a new meter the original meter must still be accuracy tested and results recorded. If the journeyman replacing the meter does not have accuracy testing equipment available, they will deliver the removed meter to a journeyman meterman so an accuracy test can be performed and recorded.

Post-Installation Testing

After the meter has been reinstalled following the task, employees must conduct a comprehensive post-installation testing procedure. This is to ensure that the meter was correctly reinstalled, and its functionality remains intact.

Testing Protocols

Employees must follow established accuracy testing protocols provided by the company. These protocols will include specific steps to test the equipment, evaluate its performance, and verify its safety.

Documentation and Reporting Requirements:

Post-Installation Report

After completing the task and reinstalling the meter, employees are required to submit a post meter test report. This report should outline the successful reinstallation, any adjustments made, and the results of the meter testing.



Meter Test Policy for Field Operations

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Exception Reporting

In cases where the meter fails the testing or exhibits issues during post-installation, employees must immediately report the situation and determine the appropriate course of action, which may include repair, replacement, or further evaluation.

Documentation Retention

All pre-removal assessments, post-installation reports, and related testing documentation must be retained according to the company's document retention policy. This ensures a historical record of equipment testing and maintenance activities.

Effective Date

This policy is effective as of 1/1/2024, and all employees are expected to adhere to its requirements from this date onward.



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UM 1384
PGE's Revision to Meter Test and Inspection Policy

Attachment D

PORTLAND GENERAL ELECTRIC METER TEST AND INSPECTION POLICY

PROCEDURES FOR MAINTAINING THE ACCURACY OF PORTLAND GENERAL ELECTRIC STANDARDS, METERS, AND METERING SYSTEMS

Previous Revision – ~~April 22, 2020~~ ~~February 5, 2014~~
Revision – ~~April 22, 2020~~ January 1, 2024

1. Scope

This document outlines the procedural requirements of Portland General Electric's (PGE or Company) scheduled electric metering test and verification programs. This policy is submitted to satisfy OAR 860-023-0015 as required by the Oregon Public Utility Commission (OPUC or Commission).

PGE deployment of solid-state Advanced Metering Infrastructure (AMI) meters occurred between 2008 and 2010 to replace in-service electromechanical meters. AMI meters allow for automated collection of meter data through a fixed two-way communication network. Adjustments to policy were made post-deployment for increased monitoring and verification purposes to ensure meter accuracies remained within acceptable tolerances.

This policy revision aligns with current industry testing methods and practices while ensuring system validation through statistical analysis.

2. General

The intent of PGE's metering policies, procedures, and practices is to properly apply, install and maintain meters and metering devices to ensure the accuracy of customer metering. No meter or metering device shall be placed in service, or allowed to remain in service, that has an incorrect watt-hour constant, that is mechanically or electrically defective, incorrectly connected, installed, or applied, or that is outside acceptable accuracy tolerances. No device shall be placed on or in a meter or metering system that could adversely affect the accuracy or performance of the meter or metering system.

PGE standards, practices and procedures for maintaining the accuracy of electric meters and metering systems are based on accepted national metering and quality standards and are maintained in compliance with applicable regulatory requirements and rules.

PGE has established practices and programs for continuing surveillance of its metering systems and customer service facilities to determine and take appropriate action

concerning hazards, failures and defects associated with metering systems and customer service facilities.

All PGE employees and contractors who perform work associated with customer metering systems shall be trained and be alert in the normal course of their daily work to identify and report safety, security, revenue and other metering defect issues.

3. References

This document references the following industry and PGE standards:

- PGE Meter ~~Services~~Operations shall communicate and implement metering policies, standards and procedures internal to the company and to applicable contractors.
- ORS 757.250 and OAR 860-023-0015 shall be used as minimum legal standards for metering system compliance.
- ANSI C12.1-~~2014~~2022 Code for Electricity Metering shall be used as a minimum maintenance standard for accuracy performance for standardizing equipment and in-service tests and metering devices.
- ANSI/ASQ Z1.4-2003 (R2013) Sampling Procedures and Tables for Inspection by Attributes shall be used as a minimum for meter acceptance testing.
- ANSI/ASQ Z1.9-2003 (R2013) Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming shall be used as a minimum standard for in-service meter sample testing.
- PGE Electric Service Requirements is used as standard for new metering and service installations.
- Public Utility Commission of Oregon Order No. 08-245 in UE 189.

4. Definitions

- (a) AMI Meter – a solid-state electronic meter which provides for two-way communications to allow the automated collection of metering data and for sending signals to the meter.
- (b) Company – Portland General Electric
- (c) Defective Meter Group – An identified homogeneous group of meters, or distinct subdivision thereof, that exceeds acceptable percent nonconforming, as defined in ANSI/ASQ Z1.9-2003 (R2013).
- (d) Homogeneous Meter Group (HMG) – A group of meters produced by the same manufacturer, having related type designation, of the same design and the same relationship of parts.
- (e) Metering System – The entire metering circuit and installation including all sensing, measuring, totalizing, registering and communication devices as well as enclosures, instrument transformers, wiring and communication links.
- (f) NIST – National Institute of Standards and Technology, under US Dept. of Commerce.
- (g) Periodic Meter Group (PMG) – A group of metering systems tested, inspected, and verified in a specific year that are on the same test frequency in a Periodic Meter Test Program.

- (h) Periodic Meter Test Program – An established scheduled pattern of meter testing and site verification where each site will be selected according to a designated regular time-interval.
- (i) Sample Meter Test Program – An established random pattern of testing meters belonging to a HMG whereby each meter has an equal opportunity to be selected for testing each year.
- (j) Uniquely Defective Meter – A meter selected for random sampling with unusable test results, including meters with broken covers, missing test data, accuracy performance characteristics greater than $\pm 5\%$ resulting from unique physical experience or unique electrical experience, and is not representative of other in-service meters in its HMG.

5. Watt-hour Standards and Standardizing Equipment

(a) PURPOSE:

To ensure watt-hour measurement equipment used to test accuracy of billing meters is calibrated and traceable to National Institute of Standards Technology (NIST).

(b) RESPONSIBILITY:

The company maintains a Standards Laboratory that is responsible for certification of all portable watt-hour standards used within PGE. The Standard Laboratory is available at all times, by appointment, during business hours for inspection or use by Commission's representatives.

(c) SUMMARY OF METHOD:

The company uses a reference watt-hour standard to compare all other watt-hour standards to ensure revenue meter accuracy. The calibration accuracy of the reference standard is verified at six-month intervals to Standard Instruments and are traceable to NIST. If the accuracy of the reference standard is outside acceptable tolerances as defined by ANSI C12.1-~~2014~~2022 Section 3, the Company shall calibrate the standard to acceptable limits, if possible. The reference watt-hour standard is stored and used in a temperature and humidity-controlled environment.

The reference watt-hour standard is used to certify portable watt-hour standards at intervals not to exceed six-months. Certifications are performed by ~~PGE's~~the Company Instrument Laboratory using a comparison method with a secondary watt-hour standard.

Documentation for all calibrations and for calibration procedures and results for each reference standard, portable watt-hour standard, and portable secondary watt-hour standard is maintained in a database system and should be kept for at least five years. A calibrated certification tag is affixed to each watt-hour standard. Each certification tag contains the calibration date, calibration result, next calibration due date, and the calibrating technician initials. Calibrations are performed following the guidance of ANSI C12.1-~~2014~~2022, ANSI code for Electric Metering.

6. Meter Quality Assurance

(a) PURPOSE:

To assure meters meet Company accuracy requirements before acceptance or installation in accordance ~~to~~with ANSI C12.1-~~2014~~2022.

(b) RESPONSIBILITY:

The meter manufacturer shall test all new single-phase and three-phase meters before being shipped to the company. The manufacturer shall provide certified test data for all new meters to the company. The Company is responsible for analysis of meter manufacturers test data to ensure accuracy specifications are met. The Company shall provide copies of its analysis of the manufacturers test data to the Commission in its next Annual Certification Report. If the Company purchased used solid-state meters, the Company is responsible for testing all the purchased meters. The Company is responsible for keeping meter test records in accordance with Section 13 of this policy.

(c) SAMPLING METHOD:

Sample testing of new meters is accomplished by selecting samples based on shipment size as defined in ANSI/ASQ Z1.4-2003 (R2013) with a General Inspection Level II, Acceptance Quality Limit (AQL) of 2.5, and Double Sampling Plan. Accuracy testing is performed based on ANSI C12.~~201~~-~~2015~~2022 Section 4.7.2, Company accuracy tolerance specifications, and includes functionality testing of ~~AMI~~ communication modules. If number of failed accuracy tests is less than limit defined in ANSI/ASQ Z1.4-2003 (R2013), shipment is accepted. ~~See Appendices for detailed acceptance testing policy.~~

The ~~Ce~~company requires ~~accuracy-percent registration within 100 % + 0.3 %~~ for new meters at light and full loads ~~to be within ± 0.3%~~ for solid-state electronic meters. Any sample test lot found to be outside acceptable accuracy limits would be held from service until repaired or replaced. Weighted percent registration is defined by ANSI C12.1-~~2014~~2022, Section 5.1.4.1; Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters.

(d) Meter Manufacturer Assessment

The Company will perform a quality assessment on each watt-hour meter supplier at intervals not to exceed five years.

7. In-Service Random Sample Meter Testing

(a) PURPOSE:

The purpose of this test program is to detect inaccurate meter groups and yield statistical information on which to base future maintenance and testing.

The in-service testing program includes watt-hour meters of the following types:

- Self-contained single-phase and three-phase revenue meters.
- Instrument transformer rated revenue meters.

(b) RESPONSIBILITY:

The Company shall report on the results of its in-service random sample meter testing in its Annual Certification Report. The Company is responsible for keeping these results for at least ten years.

(c) METHOD:

(1) Meters that communicate with Company AMI network will receive testing and inspection when identified with performance aberrations monitored on an ongoing basis as defined by Company analytics plan based on ANSI C12.1-2022, Section 5.0.3.3.

(2) Meters that do not communicate with Company AMI network will receive annual random sample testing and inspection. Random sample of meters are selected annually from each applicable Homogeneous Meter Group (HMG) using the company meter asset database and placed into sample lots. Sample lots are created and tested in the following manner:

Meters are grouped by equipment type, manufacturer, and model having the same design and relationship of parts. For large HMGs over 150,000 meters, subgroups no larger than 100,000 meters are created.

Group sample sizes are based on ANSI/ASQ Z1.9-2003 (R2013) with a General Inspection Level HI or II, Acceptance Quality Limit (AQL) of 2.5, and Double Specification Limit. General Inspection Level shall be Inspection Level II by default and may be specified at Inspection Level I if group has met switching procedure requirements defined by ANSI/ASQ Z1.9-2003 (R2013), Section A10. Maximum Allowable Percent Defective for each meter sample lot is determined from ANSI/ASQ Z1.9, Table B-3 Inspection Level II or Table B-4 Inspection Level I.

(3) The test results of uniquely defective meters are excluded from statistical analysis only if the cause of the error can be attributed to external causes or outside forces (e.g., vandalism, tampering, lightning, corrosive environment, etc.).

(d) TEST RESULTS ANALYSIS:

(1) Test results for method outlined in 7(c)(1) are analyzed based on the Company analytics plan and shall include accuracy tests of meters not identified or suspected for any known defect to safeguard against new or unstudied defects and accuracy errors and those undetectable by remote means.

(2) Random Sample plan test results for method outlined in 7(c)(2) are analyzed based on ANSI/ASQ Z1.9-2003 (R2013). If Estimated Lot Percent Defective exceeds Maximum Allowable Percent Defective for two consecutive years the lot is considered to be a "failed" lot. Meters within a failed lot will be retired within four years.

The Company shall evaluate uniquely defective meters identified within each HMG. Condition codes are assigned to uniquely defective meters based on initial condition of meter installation.

8. In-Service Periodic Meter Testing

(a) PURPOSE:

The purpose of this testing and verification program is to identify and correct inaccurate and defective metering systems. Additionally, this program is to detect inaccurate meter groups and yield statistical information on which to base future maintenance and testing.

This in-service program includes revenue meters that are for services with an average load 1MW and greater.

(b) RESPONSIBILITY:

The Company shall provide the results of its in-service periodic meter testing in its Annual Certification Report. The Company is responsible for keeping these results for at least ten years.

(c) METHOD:

Large Commercial/Industrial customers served by substation metering will receive biennial meter testing and inspection. Commercial/Industrial customers that have an average load greater than 1MW will receive biennial meter testing and inspection. Meter lots will be divided into groups based on Company equipment type and manufacturer.

A meter is defined as acceptable if as-found average accuracy is within 100 ± 0.3 percent registration. Weighted percent registration is defined by ANSI C12.1-2014/2022, Section 5.1.4.1 Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters.

All meters with an error greater than ± 0.3 % in as-found testing are removed from service. All meters with an error greater than + 5 % in as-found testing are declared

uniquely defective and removed from service. The test results of uniquely defective meters are excluded from statistical analysis only if the cause of error is attributed to external causes or outside forces (e.g., vandalism, tampering, lightning, corrosive environment, etc.).

9. Instrument Transformers

(a) PURPOSE:

To ensure that metering transformers are accurate in accordance to ANSI C12.1-~~2014~~2022 and IEEE C57.13-2016.

(b) RESPONSIBILITY:

The Company is responsible for ensuring current and voltage transformers used for revenue metering are accurate and within acceptable accuracy tolerance limits. The Company is responsible to validate manufacturer test results.

(c) ~~SUMMARY OF~~ METHOD:

The Company requires all metering current and voltage transformers be tested by the manufacturer. The manufacturer will provide the company with certified test results that verify voltage withstand, ratio correction factor, and phase angle tests were performed. All current and voltage transformers utilized for revenue metering will have an in-service test and validation performed within 90 days of installation.

(d) TESTING:

Pre-installation tests are performed by the manufacturer in accordance with ANSI C12.1-~~2014~~2022 section 5.2.1. Metering current and voltage transformers are rated at 0.3 % accuracy or better.

Field Testing/Verification complies with ANSI C12.1-~~2014~~2022 sSection 5.2.3 and sSection 5.2.4. All instrument transformers, both new and returned from service, will have a field test/verification performed within 90 days of installation. The following tests/verifications are performed after meter installation is in-service:

- ANSI C12.1-~~2014~~2022: 5.2.3.1---Burden Test
- ANSI C12.1-~~2014~~2022: 5.2.3.2---Secondary Voltage Test
- ANSI C12.1-~~2014~~2022: 5.2.4-----Inspection

(e) Instrument Transformer Manufacturer Assessment

The Company will perform a quality assessment on each instrument transformer supplier at intervals not to exceed five years.

10. Testing and Verification Methods

(a) RESPONSIBILITY:

The eCompany is responsible for operating, maintaining, and revising metering test and verification program. Tests and verifications are performed by the Company or approved contractor for the eCompany.

(b) TESTING:

Watt-hour tests are performed at 100 percent of nameplate test current (FL) and 10 percent of nameplate test current (LL) in accordance with ANSI C12.1-~~2014~~2022.

A meter is defined as acceptable if as-found average accuracy is within 100 ± 0.3 percent registration. Weighted percent registration is defined by ANSI C12.1-~~2014~~2022, [Section 5.1.4.1 Method 1 for single-phase meters and Section 5.1.4.4 Method 4 for three-phase meters](#).

(c) CALIBRATION:

Electronic meters are not calibrated.

(d) VERIFICATION OF METERING SYSTEMS:

Meter system verifications are performed on all metering installations when tested; this includes periodic and sample tests along with new, transformer service installations 90 days after the service was energized. The purpose of the verification is to assure the correctness of the meter installation and associated records, it will include the following when applicable:

- A. Meter accuracy testing
- B. Demand register testing
- C. Correctness of meter application
- D. Meter loading
- E. Correctness of billing multiplier
- F. Correctness of wiring
- G. Condition of wiring
- H. Current transformer sizing
- I. Quality and ratio of instrument transformers (verify nameplate data)
- J. Current transformer burden tests
- K. Voltage measurements
- L. Current measurements
- M. Phase angle test
- N. Instantaneous power factor measurements
- O. Security of the metering system and components
- P. Accessibility of the meter and other metering devices
- Q. Safety of the metering system and site
- R. Safety and condition of the electric distribution system
- S. Current diversion
- T. Revenue implications (i.e., customer under-billing or over-billing)

11. Security and Revenue Protection

~~PGE-The Company~~ will maintain documented procedures to ensure and verify the physical security and safety of metering installations through training of personnel, control of sealing and locking devices, and installation of seals and locking devices for meter system security and integrity. Additional controls will be used for meter information technology security. Password protections will be maintained for programmable meters to prevent unauthorized adjustment, programming or data acquisition.

Revenue validation and protection programs will include training of field and billing personnel and high/low energy usage audits designed to trigger consumption investigations. Qualified personnel are assigned the responsibility to investigate field conditions that may have loss of revenue implications.

12. Electric Service Requirements

Specific applications of the Electric Utility Service Equipment Requirements Committee (EUSERC) manual are described in the company Electric Service Requirements, available at: PortlandGeneral.com/esrESR.

13. Record Keeping

Records are maintained for all laboratory and field test standards by serial number. Records for standards are maintained for the life of the equipment plus five years. Test records are maintained for all meters and auxiliary transformers for the life of the equipment plus one year. All energy diversion investigations are recorded and records are maintained for five years.

The record of the most recent accuracy test of each instrument transformer is maintained for at least as long as the instrument transformer is in service plus three years. The record of each instrument transformer includes the manufacturer's name or trademark, type, and serial number. Each instrument transformer placed in service will be marked with the same information.

The record of the most recent accuracy test of each watt-hour meter is maintained for at least as long as the instrument transformer is in service plus three years. Accuracy record of each watt-hour meter includes the following:

- A. Date of test;
- B. Reason for test;
- C. Reading and accuracy of meter as found and as left;
- D. Identification of person who performed the test; and
- E. Identification of equipment used to test meter.

The record of each watt-hour meter includes the following:

- F. Manufacturer and date of purchase, along with any testing data provided by the manufacturer that is used by the entity for acceptance testing of the meter;
- G. Manufacturer or Company's identification number;
- H. Date and place of present or most recent installation
- I. Date and type of last major repair, or of final disposition;
- J. Nameplate data, which includes:
 - i. Form designation or circuit description;
 - ii. "Watt-hour meter" or other description;
 - iii. Manufacturer's name or trademark;
 - iv. Manufacturer's type;
 - v. Electrical current class;
 - vi. Rated voltage;
 - vii. Number of wires;
 - viii. Frequency;
 - ix. Test amperes;
 - x. Watt-hour meter constant; and
 - xi. Watt-hour meter test constant (if applicable).

14. Meter Tests Requested by Customers

If a customer requested that a meter that serves their account be tested for accuracy, the Company shall test the customer's meter, in accordance with OAR 860-021-0130.

15. Treatment of Inaccurate Metering Data

Upon discovery that a meter serving a customer is outside acceptable ~~OPUC-Commission~~ limits as defined in OAR 860-021-0130, the Company shall correct the metering error. The Company shall direct its billing department to adjust customer bills according to the corrected metering data and reimburse customer for all overcharges as defined in OAR 860-021-0135.

16. Annual Metering Management Review

~~PGE-The Company~~ will annually evaluate the currency of its metering policies, practices and procedures with updated national and state regulations, standards and guidelines. PGE will maintain a documented management review program to ensure compliance with OPUC regulations and established company policies and directives.

17. Annual Report and Certification to OPUC

~~Meter Services~~~~The Company~~ will submit an annual certification report to the Commission as set out in Section S of the ~~OPUC's-Commission's~~ Electric utility Metering Policy. Included in the report are:

- A. Company's analysis of newly purchased watt-hour meter accuracy tests provided by the manufacturers
- B. Meter group descriptions
- C. Number of meters in the group
- D. Number of meters tested per group
- E. Mean of the as-found Average Accuracy for each group
- F. Standard deviation of the as-found Average Accuracy for each group
- G. High/low range of the as-found Average Accuracy for each group
- H. Percentage above/below $100 \pm 2\%$ Average Accuracy for each group
- I. Number of meters uniquely defective per HMG group listed by cause and analysis of defects
- J. Company's analysis of in-service periodic meter testing
- K. Proposed action for future testing and maintenance based on test results
- L. Meter Audit failures listed by cause and analysis of defects for PMG's
- M. Nonconformance Revenue Implications
- N. The number of qualified personnel employed by the PGE Company
- O. Executive Summary of Annual Metering Management Review