**APPENDIX C**

# TECHNICAL DESCRIPTION OF PROPOSED METHOD FOR THE SAMPLE TESTING OF INSERVICE GAS METERS

## 1. INTRODUCTION

The Empire District Gas Company d/b/a Liberty ("EDG" or "Liberty") proposes to employ a sample testing method, using fully developed and widely recognized quality control standards, principles and rules, to test in service gas meters. These standards, principles and rules can be found in standard texts and statistical sampling tables. Details of the method are described in ANSI/ASQC ZI.4, which is the "attributes sampling technique." Sample testing is an economical substitute for one hundred percent (100%) testing.

## 2. DEFINITIONS

A) **Acceptable Quality Level (AQL)** – a statistically based acceptance criteria for the maximum percentage or proportion of variant units in a lot that can be considered satisfactory as a process average (see ANSI/ASQC Z1.4). The AQL to be used in sample testing is 6.5%.

B) **Annual Sampling** – a random sample taken each year from a group of meters based on guidelines set forth in ANSI/ASQC Z4.1 (inspection by attributes) using general inspection level II, Single Sampling Plans for Normal Inspection.

C) **Check Flow** – the measurement flow rate at twenty (20%) of the meter's rated nameplate capacity.

D) **Group** – meters of a particular manufacturer.

E) **In-test Accuracy** – the accuracy of a meter determined during its flow test following removal from operation and before repair and adjustment. It is the sum of the open flow accuracy plus the check flow accuracy divided by tow (2).

F) **Lot** – a collection of meters determined by manufacture, size and set year from which a sample is drawn and inspected to determine compliance with acceptance criteria.

G) **Meter** – a hard case diaphragm type gas meter with a flow capacity of less than 2200 standard cubic feet per hour.

H) **Open Flow** – the measured flow rate at eighty (80%) of the meter's rated nameplate capacity.

I) **Percent Accuracy** – the ratio comparison of the registered volume of a meter under test to the registered volume of a standard.

J) **Program Year** – shall be the same as a calendar year, beginning with January 1, 2023.

K) **Random** – a statistical method of sampling that ensures that each member of a population has the same probability of being selected as any other member.

L) **Set Year** – the calendar year during which a meter was installed for a customer.

M) **Specification Limits** – limits that define the conformance boundaries for the registration accuracy of individual meters. These limits are plus or minus two percent (± 2%) of one hundred percent (100%) accuracy.

N) **Year of Purchase** – the calendar year in which a meter was purchased from the manufacturer.

O) **Years of Service** – the number of years between the year a meter was set and the year it was removed.

## 3. PURPOSE

The purpose of this gas meter sample testing plan is:

A) To determine the quality level of each meter lot by providing a reliable percentage estimate of the meters in each lot lying outside the specification limits for registration

accuracy.

B) To provide information relating to the performance of various meter lots when meter accuracy does not meet the specified quality and thus provide the basis for repair and recalibration or planned retirement of those meters which are nonconforming.

## 4. GENERAL METER TESTING PROCEDURES

Meters are tested in accordance with the following:

A) With the exception of those meters removed from service specifically for known leakage, damage, tampering, noise, or non-registration, and meters that have been selected for retirement, all meters removed from service shall be tested for in-test accuracy at both check flow and open flow prior to any adjustment or repair. The meter accuracy shall be the sum of the open flow accuracy plus the check flow accuracy divided by two (2). This shall be referred to as the average in-test accuracy. Those meters that have been removed from service specifically for known leakage or non-registration shall be monitored so that potential problems with certain meter types can be identified, even though the accuracy rate is acceptable.

B) Meters shall be repaired as necessary and adjusted to within plus or minus one percent (±1%) of one hundred percent (100%) accuracy at the open and check flow rates before being returned to service.

C) Records shall be maintained for each lot of meters showing in-test accuracy of each lot for each program year. This in-test accuracy data shall be organized into three (3) accuracy categories as follows; (1) more than 2% above 100% accuracy (fast): (2) from 2% above to 2% below 100% accuracy; and (3) more than 2% below 100% accuracy (slow). The accuracy data shall be maintained by total meters tested in a lot. When

calculating the above accuracy categories, all fractions shall be rounded to the nearest one percent (1%).

**5. PERIODIC SAMPLING PROCEDURE**

Meters shall be sample tested in accordance with the procedure described herein.

A) EDG will classify its meters into groups according to manufacturer. Type or capacity further stratifies groups into lots. Each lot in every group will be sample tested annually.

B) Sampling shall be in accordance with standard sampling plans as set forth in recognized statistical quality control standards. The size of the sample will depend on the size of the lot it will represent. An additional percentage of ~~the~~ meters needed for the sample shall be selected on a random basis as substitutes for damaged, non-registering, inaccessible, or otherwise invalid meters in the sample. All meters in the sample will be tested for their accuracy for registration, where test results are rounded to the nearest one percent (1%).

C) The statistical method applied to the test data will ensure that not more than six and one half percent (6.5%) of the meters in a lot will deviate from one hundred percent (100%) accuracy of registration by more than plus or minus two percent (±2%)

D) Attributes Method

   i) Sampling by attributes can be performed several ways, usually classified as "single-sampling," "double-sampling," or "multiple-sampling." The plan selected for sampling meters in Missouri is the "single-sampling" technique.

   ii) The interest accuracy of registration of each meter in the sample is classified as either being within or beyond the 98% to 102% specification limits. The

decision to accept or reject a lot is then based upon the number of meters in the sample with accuracies beyond limits. A lot fails if the total number of meters beyond the specification limits is equal to or greater than the rejection number for the lot sample.

E) If a lot fails, EDG will remove all meters in that lot over a period not to exceed 4 years and it will replace or repair and recalibrate the meters before they can be reused. However, within a lot of meters, if a particular sub-lot can be identified from evaluation of test results which indicates an untimely performance degradation due to possible manufacturer's defect or geographical location, and is clearly not a condition brought on by age as compared to other members of the lot, the following action will be take:

   i) The particular sub-lot will be further sampled as appropriate to verify above indications.

   ii) If confirmed, an accelerated removal program of this particular sub-lot will be implemented.

   iii) In this instance the sub-lot is not indicative of the overall meter lot so the in-test accuracy data will be excluded from the analysis.

F) All other diaphragm meters, turbine meters, and rotary meters are excluded from sample testing and will be removed, inspected, and tested at least once every 120 months to ensure proper operation.