ARIZONA VALIDATING, EDITING, AND ESTIMATING (VEE) MONTHLY AND INTERVAL DATA -DRAFT

Monthly Data VEE Rules
STOPPED EDITING AT THIS POINT

1. Introduction

This document defines the data validation, editing, and estimation techniques required to participate as an MRSP for monthly data. Monthly data includes consumption, demand, and Time-of-Use (TOU) consumption and demand.

2. Required data validation checks

Data validation checks are designed to identify things that can go wrong at the meter/recorder and cause the data collected not to reflect actual usage.

The following checks are required for monthly data validation for kWh and kW data. Similar checks would apply to kVARh and kVAR data if those values are required.

Check	Purpose
Time check of meter reading device/system (applies to devices/systems collecting TOU data only)	Check for the following: • time drift of meter reading device/system outside the Applicable Regulatory Authority standard
Time check of meter (applies to meters collecting TOU data only)	Check for the following: • time drift of meter clock outside the Applicable Regulatory Authority standard
High/low usage check	Check for the following: • misread • fast/slow meter • broken meter • incorrect multipliers • energy diversion • dropped phases
High/low demand check (applies to demand readings only)	Check for the following: • misread • fast/slow meter • broken meter • incorrect multipliers • energy diversion • dropped phases

Check	Purpose
Time-of-use check (applies to TOU data only)	Check for the following: • misread • fast/slow meter • broken meter • incorrect multipliers • energy diversion • dropped phases
Zero consumption for active meters	Check for the following: • energy diversion • meter doesn't register
Usage for inactive meters	Check for the following: unauthorized usage at a site for which there is no customer with financial responsibility
Number of dials on meter	Check for the following: • wrong meter • misread
Dial decimal quantity	Check for the following: • wrong meter • misread
Meter identification	Check for the following: • that the meter ID was reported correctly • the meter has not been changed out • the data is being reported for the correct meter

3. Rules for Monthly Data Validation Check

Some monthly data validation checks must be done at the time of meter reading, and other checks could be done anytime after the meter is read until the data is posted. For example, the meter identification check must be performed at the time of the meter reading, while the high/low usage check can be performed in a handheld system as the meter is read, or back in a host system. All checks are not applicable to all types of data. The following table summarizes which checks must be done for each type of data, and provides a recommended sequence.

Check	Must be done at time of meter read?	Consumption	Demand	TOU Consumption	TOU Demand
Time in meter	Yes	n/a	n/a	3	3

Check	Must be done at time of meter read?	Consumption	Demand	TOU Consumption	TOU Demand
High/Low usage	No	3	n/a	4	n/a
High/Low demand	No	n/a	3	n/a	4
TOU usage	No	n/a	n/a	6	n/a
Zero consumption for active meters	No	4	n/a	5	n/a
Number of dials	Yes	2	n/a	2	n/a
Number of demand decimal places	Yes	n/a	2	n/a	2
Meter ID	Yes	1	1	1	1

Most of the checks and estimation algorithms are based on historical data for the same customer and the same site. In areas with wide fluctuations in weather, this may not provide the best data for residential customers, as residential usage patterns vary much more with changes in weather than larger customers. A separate set of High/Low usage validation check and estimation rules are provided based on day-before usage of similar customers in the same geographic area.

3.1. Time check of Meter Reading Device/System

This check only applies for meter reading devices and systems collecting Time-of-Use data. Time check of meter reading device/system ensures that the collection device is synchronized to a national time standard before data collection begins

3.2. Time tolerance check of meter

The time tolerance check is only required if the meter is collecting Time-of-Use (TOU) data. It verifies that the meter's time is correct, and that TOU data represents the appropriate time periods. Note that depending on the communication technology used, network latency must be taken into account.

3.2.1. If time in meter is within +/- 3 minutes of the time standard, the data has passed Time Tolerance check. Note that if the meter is within +/- 3 minutes of the standard, the time in the meter can optionally be corrected.

3.2.2. If time in meter is off > 3 minutes but <= 55 minutes, the data passes the Time Tolerance check. The data does not need to be estimated, but the MRSP must record the fact that the meter's time was off by this amount in case there is a later question about the data. The meter time may optionally be reset.

3.2.3 If time in meter is off > 55 minutes, the data fails the time tolerance check and must be estimated. The time in the meter must be reset. If the meter fails the time tolerance check after being reset for three consecutive months, the meter must be physically inspected/tested.

3.3. High/Low Usage

The High/Low Usage check validates cumulative consumption (kWh). Two methods are provided - one based on historical data, and one based on previous day data from similar customers. An MRSP may implement either check, depending on weather characteristics and density of meter population served by the MRSP. The second check requires a minimum density of meter population to be statistically accurate; this still needs to be determined.

3.3.1 Method based on historical data

3.3.1.1. Calculate the average daily usage (ADU) for the present billing period.

For example, if all constants and factors have already been applied to the reads, the ADU could be calculated by:

ADU = (current billing read - previous billing read)/(# days between billing reads)

If the previous billing read were on June 1, and the present billing read is on June 30, there would be 29 days between billing reads.

3.3.1.2. Calculate the historical ADU

3.3.1.2.1 If there is not at least one month (minimum 27 days) of historical billing data available for the same customer and site, this check is not performed.

3.3.1.2.2. If data for the same customer and site is available, calculate the ADU for the same billing period last year. Use this as the

historical billing ADU. One way to determine which billing period last year is "the same" is to choose the mid-point of this year's billing period, and find the billing period last year that included the same date. For example, if the billing period this year was from April 13 to May 13, the mid-point would be April 28. If the billing period has an even number of days, use the day after the middle as the mid-point. For example, if the billing period was from June 1 to June 30, the mid-point would be June 16. Another way to determine which billing period is "the same" is to find the billing period last year with its read date in the same calendar month as the read date of the data being validated.

3.3.1.2.3 If there is no data from a year ago but there is data for the last billing period (minimum 27 days), calculate the ADU for the last billing period and use this as the historical ADU.

3.3.1.3. Compare the present billing period ADU with the historical billing period ADU. If the present billing period ADU is between 40% and 200% (inclusive) of the historical ADU, the data passes this check. (Note that some systems may convert ADU to a billing period usage to perform the check.) Optional trend factors that take into account peer group usage based on demographics, climactic areas, and customer class may be applied to the ADU to refine the High/Low comparison check. Sample trend factor calculations are to be provided at a later date.

3.3.1.4. If the present billing period ADU is not within 40% to 200% (inclusive) of the historical billing period ADU, the data fails this check. Optionally re-read the meter.

1. If the reread is essentially at the same time as the original read and a different value is obtained, assume the first reading was a misread and perform the check again with the new reading. If the same reading was obtained, assume the meter reading is

correct; the data failed the High/Low Usage check but is verified. OR

2. If the reread is not at the same time as the original read, re-compute the average daily usage using the new reading. If the new ADU is within +/- 20% of the previous ADU, the data fails the High/Low usage check but is verified. If the new ADU is not within +/- 20% of the previous ADU, the data fails the High/Low usage check.

3.3.1.5. Data that fails the High/Low usage check and has not been verified may be investigated and manually verified if justification is found; otherwise the data must be estimated.

3.3.2. Method based on previous day usage of similar customers

Note that this method requires a certain density of customer data for residential customers in the same geographic area, where weather patterns are typically consistent throughout the geographic area.

3.3.2.1. The following steps are performed at the end of each meter reading cycle day for each geographical area in order to validate and estimate usage the following day:

3.3.2.1.1. At the end of the reading day, for each good meter read (open account, billed, between 27-33 days & ADU =< 100), perform the following calculations to determine an ADU for the billing period:

1. Calculate ADU (= KWH/days in billing period)
2. Add ADU to Sum of Current ADU
3. Calculate ADU squared
4. Add ADU squared to Sum of Current ADU squared
5. Add 1 to total meters
6. Calculate last month's ADU
7. Calculate current ADU times last month's ADU
8. Calculate last month's ADU squared

3.3.2.2. Determine which range of usage (high, medium or low) the current ADU should be

grouped with by comparing current ADU to yesterdays ADU Low and High Range Factors (Reference 3.3.2.1.3 for ADU low and high range factor calculation methodology)

1. If the current ADU is less than yesterday's ADU low range factor:
   - Add current ADU to Sum of current low ADU
   - Add last month's ADU to Sum of last month's low ADU
   - Add current ADU times last month's ADU to Sum of current low ADU times last month's ADU
   - Add current ADU squared to Sum of current low ADU squared
   - Add last month's ADU squared to Sum of last month's low ADU squared
   - Add 1 to total low meters

2. If the current ADU is not less than the ADU low range factor from yesterday and is less than the ADU high range factor, add the figures to the medium range following same format is in 3.3.2.1.2. step 1.

3. Otherwise, add the current ADU to the ADU high range following the same format in 3.3.2.1.2. step 1.

3.3.2.1.3. Calculate an aggregated ADU for current data for each geographic area

3.3.2.1.3.1. Sum together the ADU values for each geographic area

3.3.2.1.3.2. Calculate the mean for the total ADU (=Sum of Current ADU / total meters)

3.3.2.1.3.3. Calculate the standard deviation for the total

3.3.2.1.3.4. Calculate the current ADU low and high range factors:

- ADU Low Range Factor = mean - .43 Standard Deviation. If ADU Low range factor is less than the total current mean * .5, the ADU low range factor becomes the mean half.
- ADU High Range Factor = mean + .43 Standard Deviation
- NOTE: By determining the low & high factors, the Medium Range = (mean - .43 Standard Deviation) to (mean + .43 Standard Deviation)

3.3.2.1.4. For each of the three ranges determined above (low, medium, and high), calculate a percent of change of monthly usage for each geographic area.

3.3.2.1.4.1. After each meter's current billing period's (ADU) is grouped in 3 Ranges (Low, Medium, and High) as specified in 3.3.2.1.2, the following data are summed up by ADU range and area:

- Number of customers
- Sum of all last month's ADU
- Sum of all current month's ADU
- Sum of {each last month's ADU times current month's ADU}
- Sum of {all last month's ADU squared} i.e., Square all ADU, then sum them.
- Sum of {all current month's ADU squared}

From the data above modified ADU mean factors and standard deviation

factors are determined for each range as follows:

Modified Mean Factor:
Sum of {last month ADU times current month ADU} divided by the sum of {all last month's ADU squared}

Modified Standard Deviation Factor:

Step 1: (Sum of {all current month's ADU squared} minus (Mean squared times sum of {all last month's ADU squared}) divided by (Total Meters minus 1).

Step 2: Take square root of Step 1

3.3.2.1.5. Calculate high and low range factors.

Calculate high and low range factors (HRF and LRF) for each of the 3 usage ranges within a geographic area. The mean is used to calculate estimated reads, and the high and low range factors are used in this validation check. 2.8 and 3.5 are used in the below example to represent the range deviation factor and will allow for an appropriate meter read error rate. This factor can be changed to control the error rate.

High Range Factor Formula:
HRF = 1 + {(2.8X Modified Standard Deviation X Number of meters) / (Sum of Current month's ADU)}

Low Range Factor Formula:
LRF = 1 - {(3.5 X Modified Standard Deviation X Number of meters) / (Sum of Current month's ADU)}

3.3.2.2. As each meter is read, perform the following using the values calculated from the previous meter reading days' data.

3.3.2.2.1. Determine the usage from the preceding billing month and the preceding billing reading for the customer and site.

3.3.2.2.2. Calculate low limit for this month's usage by multiplying the preceding month's usage by the low range factor determined above.

3.3.2.2.3. Calculate high limit for this month's usage by multiplying the preceding month's usage by the high range factor determined above.

3.3.2.2.4. If the current usage is between the low and high limit calculated in the previous two steps, the data passes the High/Low check.

The following is a representation of how the High and Low Range Factors are used to validate meter usage:

Sample High/Low Usage Check:

Customer's previous usage = 400 kWh

High Range Value: 400kwh X 1.115 HRF* = 446
Low Range Value:400kwh X .885 LRF* = 354

Usage values falling between 354 and 446 are accepted. Usage values outside this range fail the check.

* HRF/LRF = High and Low Range Factors, see description above.

3.3.2.2.5. If the current usage is outside the low and high limit, the data fails the High/Low check. Optionally re-read the meter.

1. If the reread is essentially at the same time as the original read and a different value is obtained, assume the first reading was a misread and perform the check again with the new reading. If the same reading was obtained, assume the meter reading is correct; the data failed the High/Low Usage check but is verified. OR

2. If the reread is not at the same time as the original read, re-compute the average daily usage using the new reading. If the new ADU is within +/- 20% of the previous ADU, the data fails the High/Low usage check but is verified. If the new ADU is not within +/- 20% of the previous ADU, the data fails the High/Low usage check.

3.3.2.2.6. Data that fails the High/Low usage check and has not been verified may be investigated and manually verified if justification is found; otherwise the data must be estimated.

3.4. High/Low Demand

The High/Low Demand Check compares the demand against historical data as a reasonableness check.

3.4.1. Determine the peak demand for this billing period.

3.4.2. Determine the historical peak demand.

3.4.2.1. If there is not at least one month (at least 27 days) of historical billing demand data available, skip this check.

3.4.2.2. If demand data for this customer and site is available for the same billing period last year, use that as the historical peak demand. (Refer to section 3.3.1.2.2 to determine same billing period last year.)

3.4.2.3. If demand data is not available for the same billing period last year but there is demand data for the last billing period, use the peak demand from the preceding billing month as the historical peak demand.

3.4.3. Compare the present peak demand with the historical peak demand. If the present peak demand is between 40% and 200% of the historical peak demand, the data passes this check.

3.4.4. If the present peak demand is not within 40% to 200% of the historical peak demand, the data fails the High/low demand check. Optionally re-read the meter if the same data is still available in the meter. For example, the same data would still be available if

demand reset has not yet been performed or meter stores preceding billing period data.

1. If the reread is essentially at the same time as the original read and a different value is obtained, assume the first reading was a misread and perform the check again with the new reading. If the same reading was obtained, assume the meter reading is correct; the data failed the High/Low Demand check but is verified. OR

2. If the reread is not at the same time as the original read and the new demand value is within +/- 20% of the previous demand value, the data fails the High/Low demand check but is verified. If the re-read results in the same value, the data fails the High/Low demand check but is verified.

3.4.5. Data that fails the High/Low Demand check and has not been verified may be investigated and manually verified if justification is found. Otherwise the data must be estimated.

3.5. TOU Usage

The TOU usage check compares the sum of the kWh meter readings for all periods against the current season total kWh meter reading. Note that this check must be done in whatever units are read from the meter. For example, if the meter provides kWh, the kWh values must be summed and compared. If the meter provides pulses, the pulse values must be summed and compared.

3.5.1. For the current billing period, calculate the total kWh by summing all the periods, including all seasons.

3.5.2. Compare the calculated total kWh with the current total kWh read from the meter. If they are within +/- the number of periods (active or inactive) summed together, the data passes the check. If they are not, the data fails the TOU Usage check and must be estimated. (Note: some TOU rates may include more periods in one season than another, causing “inactive” periods. For example, a summer season may have three periods, and a winter season only two. The period that appears only during the summer is “inactive” during the winter season.)

For example, assume there were two periods, peak and off-peak, and a season change occurred during the month.

Period	Previous Season	Current Season

Peak	50	150
Off-Peak	100	200

Determine the valid range by calculating the sum of the periods +/- the number of periods, or (50 + 100 + 150 + 200) +/- 2. If the current total kWh read from the meter was between 488 and 502 inclusive, the data would pass the check. If the current total kWh read from the meter was less than 488 or greater than 502, the data would fail the check.

If the meter is programmed to provide readings for all but one of the periods, this test is modified to verify the sum of the periods with readings is <= the total kWh.

3.6. Zero Consumption for Active Meters

The Zero Consumption checks for zero usage during the billing month.

3.6.1. If the meter is an active meter (i.e., is associated with a customer who has financial responsibility), calculate the usage for the present billing month.

3.6.2. If the usage is greater than 0, the data passes the zero consumption check.

3.6.3. If the usage is 0, the data failed the zero consumption check. Optionally verify the meter reading by re-reading the meter and/or testing the meter. If the reread is the same and the usage is still 0, the data failed the Zero Consumption check but is verified. If a new, different meter reading is obtained, run all the checks again using the new data

3.6.4. Data that fails the zero consumption check may be manually investigated and verified if justification is found (for example, a building or equipment that is only used seasonally). If the data is not validated or verified, it must be estimated.

3.7. Usage for Inactive Meters

An inactive meter is one for which there is no customer with financial responsibility. This does not apply to non-UDC MRSPs and is not a required check.

3.8. Number of Dials on Meter

This check applies to cumulative consumption only. It checks that the number of "dials" (digits) reported in the read is consistent with the number of dials (or digits) on the meter display. This check is

performed for both remote and local reads if supported by the meter reading technology. If the meter reading technology doesn't support this check, it is not performed.

3.8.1. Determine the number of digits in the meter reading.

3.8.2. If the number of digits in the meter reading is consistent with the number of digits/dials on the meter, the data passes this check.

3.8.3. If the number of digits is not consistent, re-read the meter to verify that the correct meter is being read and that it has the correct number of digits/dials. If the re-read provides the same values, the meter reading failed the Number of Dials on Meter check but is verified. The situation must be investigated and records must be corrected. If the re-read produces different values, perform the check again with the new values.

3.9. Meter Read Demand Decimal Quantity Difference

The Meter Read Demand Decimal Quantity Difference check verifies that the number of demand decimal places displayed on the meter is correct. Note this check is only performed for on-site meter reads, and is not performed for remote meter reads.

3.9.1. When the meter is read on-site, the meter reader compares the number of decimal places displayed by the meter with the number of decimal places expected. If they are the same, the reading passes the Meter Read Dial Decimal Quantity check.

3.9.2. If they are not the same, re-read the meter to verify that the correct meter is being read and that it has the correct number of decimal places. If the re-read provides the same values, the meter reading failed the Meter Read Dial Decimal Quantity Difference check but is verified. The situation must be investigated and records must be corrected. The meter may need to be re-programmed. If the re-read produces different values, perform the check again with the new values.

3.10. Meter Identification

There are two types of Meter Identification checks depending on how the meter is read - Internal Meter Identification check and External Meter Identification check. The following table summarizes when each check is required:

Meter Reading Method	Perform External ID Check?	Perform Internal ID Check?
Remote	No	Yes
Optical Port	Yes	Yes
Manual	Yes	No

1. If the meter is read remotely or via its optical port, the Internal Meter Identification check is performed. This compares the meter's internal identification (often its serial number) with the identification expected by the meter reading system. If they match, the data passes this check. If they don't match, the MRSP must investigate why the meter is different than indicated by their records and resolve the inconsistency

2. If the meter is red locally (including via an optical port), the External Meter Identification Check is performed. This compares the Meter ID on the meter nameplate with the Meter ID expected by the meter reading system If they match, the data passes this check. If they don't match, the MRSP must investigate why the meter is different than indicated by their records and resolve the inconsistency.

3.11. Irregular Usage Monthly Data

An irregular usage customer is one whose usage pattern at a specific location does not follow normal usage patterns and consistently fails the High/Low usage or zero consumption for active meters checks. A customer may be determined to be an irregular usage customer by an MRSP if the MRSP verifies that:

1. the customer data fails the standard validation check for three consecutive months, and that the data represents the actual customer usage, OR
2. the MRSP is notified by the customer's previous MRSP.

The data used to determine a customer is an irregular usage customer could be data collected by the MRSP, or historical data provided by the previous ESP or MRSP. An ESP may notify the MRSP that a customer is a potential irregular usage customer based on conversations with the customer, triggering an inspection of the data. If a customer is determined to be an irregular usage customer, the MRSP may optionally omit the check the customer normally fails. For example, if an irregular usage customer typically fails the High/Low usage check but not the zero consumption

check, the zero consumption check must still be performed but the high/low usage check may be omitted. The MRSP must notify both the customer's ESP and UDC of the customer's irregular usage status and what checks will not be performed.

For some customers, irregular usage patterns are symptomatic of the business and will always be present, such as agricultural or seasonal customers. For other customers, irregular usage patterns may be a temporary condition, such as when a factory adds a second shift and fails the high/low usage check for the first 12 months. The MRSP must determine whether a customer is a permanent or temporary irregular usage customers. Temporary irregular usage customers must be reviewed at least annually to determine if they are still irregular usage customers or should be returned to the normal checks.

4. Monthly Data Estimation Rules

Note that the MRSP must record the estimation algorithm used for each data element that is estimated. The MRSP must retain this information for the same period required for raw and validated data (3 years). Monthly data estimation algorithms include:

- Estimation based on previous year's data
- Estimation based on preceding billing period's data (>= 27 days)
- Estimation based on similar customers
- Estimated demand based on average load
- Other estimation method (MRSP must document when this is used)

4.1. Estimating Usage

Two methods to estimate usage are provided. They are similar to the two methods of performing the High/Low Usage check. The first is based on historical usage for the same customer and site; the second is based on historical usage for the same customer and site combined with a factor based on present usage of customers of the same class and same geographic area. The number of decimal places included in ADU calculations must be sufficient so that significant rounding errors do not occur. The recommended value is 2 decimal places. Final estimated usage is truncated to an integer.

4.1.1. Method 1 - Based on Historical Usage

4.1.1.1. Calculate ADU to be applied

4.1.1.1.1. If billing data is available from the same customer and same site for the same billing period last year and it is not estimated, calculate the ADU for the same billing period last year and use this value as the ADU. Refer to section 3.3.1.2.2 to determine the same billing period last year. Optional trend factors that take into account peer group usage based on demographics, climactic areas, and customer class may be applied to the ADU to provide a more accurate estimation. Sample trend factor calculations are to be provided at a later date.

In this case, the estimation algorithm is estimation based on previous year's data.

4.1.1.1.2. If there is no data from the previous year but there is a full preceding billing month (at least 27 days) calculate the ADU for the preceding billing month and use this value for the ADU. In this case, the estimation algorithm is estimation based on preceding billing period's data.

4.1.1.1.3. If neither of the previous two options are available, data must be estimated based on any available data, such as similar customers, load profiles, average usage for the customer class, meter reads since last billing read, other historical data, etc. In this case, the estimation algorithm is other estimation algorithm. The MRSP must document how the data is estimated.

4.1.1.2. Calculate the number of days since the last good meter reading within the current billing cycle to the end of this billing period. If the meter is read monthly, this would typically be last month's billing meter reading. If the meter is read more frequently, this could be more recent than last month's billing reading.

4.1.1.3. Multiply the ADU (including any constants or factors) by the number of days since the last good reading. If necessary, divide this value by a meter constant or other

factor to convert it to the same units reported in the meter reading. Truncate the value to an integer, and add the truncated value to the last good reading to obtain an estimated reading. This is the estimated meter reading. Mark the reading as being estimated using the appropriate algorithm.

4.1.2. Method 2 - Based on historical usage and similar customers

4.1.2.1. For the residential meter population (i.e., same geographic area and customer class), utilize the following determinants as determined in 3.3.2:

- ADU Low Range Factor (3.3.2.1.3.4)
- ADU High Range Factor (3.3.2.1.3.4)
- Low Range Modified Mean Factor (3.3.2.1.4.1)
- Medium Range Modified Mean Factor (3.3.2.1.4.1)
- High Range Modified Mean Factor (3.3.2.1.4.1)

4.1.2.2. Calculate the ADU from last month's billing period for that customer.

4.1.2.3. Calculate the modified ADU for a specific meter by multiplying last month's ADU (from step 4.1.2.2) by yesterday's medium range modified mean factor (above) for that geographical area.

4.1.2.4. Determine if the modified ADU is in yesterday's low, medium, or high range.

- If the modified ADU is less than the ADU low range factor, yesterday's low range modified mean factor is used to calculate estimated ADU in the succeeding steps.
- If the modified ADU is equal to or greater than ADU low range factor but less than the ADU high range factor, yesterday's medium range modified mean factor is used to calculate estimated ADU in the succeeding steps.

- If the modified ADU is greater than or equal to the ADU high range factor, yesterday's high range modified mean factor is used to calculate estimated ADU in the succeeding steps.

4.1.2.5. Multiply the prior ADU by the modified mean factor determined in 4.1.2.4. This becomes the new estimated ADU.

4.1.2.6. Continue with steps 4.1.1.2, and 4.1.1.3 using the estimated ADU calculated in the preceding step.

4.2. Estimating Demand

4.2.1. If demand data is available from the same customer and same site for the same billing period last year and it is not estimated, use that demand as the estimated demand. Refer to section 3.3.1.2.2 to determine the same billing period last year. In this case, the estimation algorithm is estimation based on previous year's data.

4.2.2. If there is no demand data from the previous year but there is demand data from a full preceding billing month (at least 27 days), use the preceding month's demand as the estimated demand. In this case, the estimation algorithm is estimation based on preceding billing period's data

4.2.3. If neither of the above two options are available, calculate the average demand for the billing period. This is done by dividing the actual or estimated usage by the number of hours in the billing period. Use this value as the estimated demand. For example, if the billing period is 30 days, divide the usage for the billing period by 720 (the number of hours in 30 days)

4.3. Estimating TOU Usage

For missing TOU usage data, each period must be estimated separately, using historical data from the same TOU period (defined by time frames) and season as the data requiring estimation. Optional trend factors that take into account peer group usage based on demographics, climactic areas, and customer class may be applied to the ADU to provide a more accurate estimation. Sample trend factor calculations are to be provided at a later date. The number of decimal places included in ADU calculations must be sufficient so that significant rounding errors do not occur. The recommended value is 2 decimal places. Final estimated usage is truncated to an integer.

4.3.1. For each period requiring estimation, the following steps are performed. Note that if there is a season change during the time period requiring estimation, each season needs to be done separately. If season crossover occurs in the month requiring estimation, reference data could be selected from the last month with crossover between the same seasons, or the last full month of the season. There are two cases to consider. For example:

1. If season changes occur on October 1 and May 1, and the billing month April 15 to May 15 (including the season crossover) requires estimation, reference data for the winter period may be chosen from the billing period that contained the October 1 crossover, or from the preceding billing month. Reference data for summer could be chosen from the billing period that contained the October 1 crossover, or from the last full summer month. If the reference month selected does not contain the same seasons as the month requiring estimation, an appropriate month containing the correct seasons should be selected.
2. If season changes occur on October 1 and May 1, and the billing month May 15 to June 15 requires estimation, reference data may be chosen from the billing period that contained the last full month of summer data, or from the summer portion of the preceding billing month.

4.3.1.1. Calculate ADU to be applied

4.3.1.1.1. If billing data is available from the same customer, same site, and same TOU period for the same billing period last year, and last year's data is not estimated, calculate each period's ADU for the same billing period last year and use the values as each period's ADU. Refer to section 3.3.1.2.2 to determine the same billing period last year. For example, if the billing period this year was from April 13 to May 13, the mid-point would be April 28. If a season change occurred during the month, use data from the appropriate season as reference data. Optionally, use data from the month before

or after the same billing period last year to get at least one week's worth of data for the season. In this case, the estimation algorithm is estimation based on previous year's data.

4.3.1.1.2. If there is no data from the previous year but there is at least one month's data (minimum 27 days) available from the preceding billing month and it is not estimated, calculate each period's ADU for the preceding billing month and use the values for each period's ADU. If a season change occurred during the month, use data from the appropriate season as reference data. Optionally, use data from the month before or after the same billing period last year to get at least one week's worth of data for the season. In this case, the estimation algorithm is estimation based on preceding billing period's data.

4.3.1.1.3. If there is less than one week's historical data available, each period's data must be estimated by other methods based on any available data, such as similar customers, load profiles, average usage for the customer class, meter reads since last billing read, other historical data, etc. In this case, the estimation algorithm must be documented. The estimation algorithm is other estimation algorithm.

4.3.1.2. Calculate the number of days since the last good meter reading within the current billing cycle to the end of this billing period for each period requiring estimation. If the meter is read monthly, this would typically be last month's billing reading. If the meter is read more frequently, this could be more recent than last month's billing reading.

4.3.1.3. For each period, multiply the ADU for that period by the number of days requiring estimation. This is the estimated usage by period. Sum the periods to derive the total estimated usage for the billing period. Mark the reading as being estimated using the appropriate algorithm.

4.4. Estimating TOU Demand Data

For missing TOU demand data, estimate each period required for billing separately. Note that if there is a season change during the time period requiring estimation, each season needs to be done separately.

4.4.1. For each period requiring estimation, the following steps are performed. Note that if there is a season change during the time period requiring estimation, each season needs to be done separately. If season crossover occurs in the month requiring estimation, reference data could be selected from the last month with crossover between the same seasons, or the last full month of the season. There are two cases to consider. For example:

1. If season changes occur on October 1 and May 1, and the billing month April 15 to May 15 (including the season crossover) requires estimation, reference data for the winter period may be chosen from the billing period that contained the October 1 crossover, or from the preceding billing month. Reference data for summer could be chosen from the billing period that contained the October 1 crossover, or from the last full summer month. If the reference month selected does not contain the same seasons as the month requiring estimation, an appropriate month containing the correct seasons should be selected.
2. If season changes occur on October 1 and May 1, and the billing month May 15 to June 15 requires estimation, reference data may be chosen from the billing period that contained the last full month of summer data, or from the summer portion of the preceding billing month.

4.4.1.1. If demand data is available from the same customer and same site for the same billing period last year and it is not estimated, use that demand as the estimated demand. Refer to section 3.3.1.2.2 to determine the same billing period last year. In this case, the estimation algorithm is estimation based on previous year's data.

4.4.1.2. If there is no demand data from the previous year but there is demand data from a full preceding billing month (at least 27 days), use the preceding month's demand as the estimated demand. In this case, the

estimation algorithm is estimation based on preceding billing period's data.

4.4.1.3. If neither of the above two options are available, calculate the average demand for the billing period. This is done by dividing the actual or estimated usage by the number of hours in the billing period. Use this value as the estimated demand. For example, if the billing period is 30 days, divide the usage for the billing period by 720 (the number of hours in 30 days).

Attachment C-VEE-A:
Interval Data VEE Technical Methods

Removed in agreement – refer to 3.2

1.2. Sum Check Failure Troubleshooting Techniques

The objective of the sum check is to compare the energy use recorded by the meter to the energy use recorded by the pulse recorder over the same time period. Due to data collection methods, often the period represented by the meter reads does not correspond exactly to the period represented by the interval data. For example, the period of data collection may span from 5/1/98 01:12 AM to 6/1/98 01:22 AM, with the meter readings corresponding exactly to this time period. With 15-minute interval data, the interval data for this same period of data collection would begin at 5/1/98 01:00 AM and end at 6/1/98 01:15 AM. The difference of 12 minutes from the start meter reading and 7 minutes from the end meter reading could be the source of error in the failure of the sum check.

1.2.1. Account for Start and End Time Differences

The following technique enables the MRSP to resolve sum check failures by taking into account time differences between the meter readings and the interval data.

Redo the sum check, taking into account the differences in time between the time of the start read and the start of the first interval, and the time of the stop read and the end of the last interval:

1) Calculate a prorated start meter reading to be used in this check by doing the following:

(a) Calculate the percentage of an interval that has elapsed between the start time of the first interval and the time of the start meter reading. For example, if the meter was read at 3:30 PM, the first interval in an hourly interval data stream would start at 3:00 PM. The percentage of time elapsed is (30 min./60 min.) = 50%.

(b) Multiply the usage from the first interval by the percentage from the previous step. For example, if the usage in the first interval is 240 kWh, the percentage usage is (240*0.50) = 120 kWh.

(c) Determine how many meter increments are represented by the percentage usage from the previous step. For a meter

multiplier of one, the usage is equal to the number of meter increments, so 120 kWh is equal to 120 meter increments. For a meter multiplier of 80, 120 kWh is equal to 1 meter increment (i.e., 120 divided by 80 and rounded down to the nearest integer).

(d) Calculate a prorated start meter reading by subtracting the number of meter increments from the previous step from the actual start meter reading. For example, if the start meter reading is 55555, and the number of meter increments is equal to 120, the prorated start meter reading would be (55555-120) = 55435.

2) Calculate an allowable margin of error to be used in this check by doing the following:

(a) Calculate the percentage of an interval that has elapsed between the end time of the last interval and the time of the stop meter reading. For example, if the meter was read at 11:15 AM, the last interval in an hourly interval data stream would start at 11:00 AM. The percentage of time elapsed is (15 min./60 min.) = 25%.

(b) Multiply the usage from the last interval by the percentage from the previous step. For example, if the usage in the last interval is 120 kWh, the percentage usage is (120*0.25) = 30 kWh.

(c) Determine how many meter increments are represented by the percentage usage from the previous step. For a meter multiplier of one, the usage is equal to the number of meter increments, so 30 kWh is equal to 30 meter increments. For a meter multiplier of 80, 30 kWh would result in .375 meter increments.

(d) Calculate the allowable margin of error by adding 2 to the value calculated in the previous step.

(e) Redo the sum check using the prorated start and original stop meter readings and the allowable margin of error instead of the two multipliers.

1.2.2. Account for Missing or Incomplete Intervals

With some metering and data collection technologies, it is possible for the meter or cumulative usage register to reflect accurate usage even when the interval data is missing or incomplete. The following technique enables the MRSP to resolve the sum check failure for those intervals that were successfully collected.

If some intervals are missing or incomplete, redo the sum check after scaling the difference between the adjusted start read and the stop read by the percentage of good intervals:

1) Count the number of good intervals in the data stream.

2) Calculate the percentage of good intervals by dividing the count from the previous step by the number of intervals elapsed between start time and stop time.

3) Multiply the percentage by the difference between the start reading and the stop reading. (Note that you may use the actual start and stop readings or the prorated start and stop readings from 1.2.1 in this step.)

4) Compare the new difference with the sum of the usage in the good intervals. Note that the values must be in the same units for the comparison.

5) If the difference is <= allowable margin from 1.2.1, the good intervals pass the sum check. The missing or incomplete intervals need to be estimated.

1.3. Scaling estimated data using good meter readings

If start and stop meter readings are available and are known to be good, they may optionally be used to scale the estimated interval data as follows:

1) Determine the total usage for the time period based upon the meter readings.

   Total Usage = ((Stop Reading-Start Reading)*Meter Multiplier)

2) Sum together the valid intervals.

3) Subtract the sum of the valid intervals from the total usage to determine the total estimated usage.

   Total Estimated Usage = Total Usage – Sum of Valid Intervals

4) Sum together the previously estimated intervals.

5) Calculate the scaling factor by dividing the total estimated usage by the sum of the estimated intervals.

   Scaling Factor = Total Estimated Usage/Sum of Estimated Intervals

6) Multiply each estimated interval by the scaling factor.

Attachment C-VVE-B

Monthly Data VEE Technical Methods

This attachment provides an example of validating and estimating usage based on previous day usage of similar customers. The numbers to the left of the text correspond to the numbers on the spreadsheet at the end of the attachment

3.3.2. Method based on previous day usage of similar customers

Note that this method requires a certain density of customer data for residential customers in the same geographic area, where weather patterns are typically consistent throughout the geographic area.

3.3.2.1. The following steps are performed at the end of each meter reading cycle day for each geographical area in order to validate and estimate usage the following day:

→
Represents the numerical association on the attached spreadsheet calculations. Used for mapping only.

3.3.2.1. At the end of the reading day, for each good meter read (open account, billed, between 27-33 days & ADU =< 100), perform the following calculations to determine an ADU for the billing period:

1 → 1. Calculate ADU (= KWH/days in billing period)
2. Add ADU to Sum of Current ADU
2 → 3. Calculate ADU squared
4. Add ADU squared to Sum of Current ADU squared
5. Add 1 to total meters
3 → 6. Calculate last month's ADU
4 → 7. Calculate current ADU times last month's ADU
5 → 8. Calculate last month's ADU squared

3.3.2.1.2. Determine which range of usage (high, medium or low) the current ADU should be grouped with by comparing current ADU to yesterdays ADU Low and High Range Factors (Reference 3.3.2.1.3 for ADU low and high range factor calculation methodology)

6 →

1. If the current ADU is less than yesterday's ADU low range factor:
- Add current ADU to Sum of current low ADU
- Add last month's ADU to Sum of last month's low ADU
- Add current ADU times last month's ADU to Sum of current low ADU times last month's ADU
- Add current ADU squared to Sum of current low ADU squared
- Add last month's ADU squared to Sum of last month's low ADU squared
- Add 1 to total low meters

2. If the current ADU is not less than the ADU low range factor from yesterday and is less than the ADU high range factor, add the figures to the medium range following same format is in 3.3.2.1.2. step 1.

3. Otherwise, add the current ADU to the ADU high range following the same format in 3.3.2.1.2. step 1.

3.3.2.1.3. Calculate an aggregated ADU for current data for each geographic area

7 → Sum together the ADU values for each geographic area

8 → Calculate the mean for the total ADU (=Sum of Current ADU / total meters)

9 → Calculate the standard deviation for the total

Calculate the current ADU low and high range factors:

10 →
- ADU Low Range Factor = mean - .43 Standard Deviation. If ADU Low range factor is less than the total current mean * .5, the ADU low range factor becomes the mean half.

11 →

- ADU High Range Factor = mean + .43 Standard Deviation
- 12 → NOTE: By determining the low & high factors, the Medium Range = (mean - .43 Standard Deviation) to (mean + .43 Standard Deviation)

3.3.2.1.4. For each of the three ranges determined above (low, medium, and high), calculate a percent of change of monthly usage for each geographic area.

3.3.2.1.4.1. After each meter's current billing period's (ADU) is grouped in 3 Ranges (Low, Medium, and High) as specified in 3.3.2.1.2, the following data are summed up by ADU range and area:

- 13 → Number of customers
- 14 → Sum of all last month's ADU
- Sum of all current month's ADU
- 15 → Sum of {each last month's ADU times current month's ADU}
- 16 → Sum of {all last month's ADU squared} i.e., Square all ADU, then sum them.
- 17 → Sum of {all current month's ADU squared}
- 18 →

From the data above modified ADU mean factors and standard deviation factors are determined for each range as follows:

Modified Mean Factor:

19 → Sum of {last month ADU times current month ADU} divided by the sum of {all last month's ADU squared}

Modified Standard Deviation Factor:

Step 1: (Sum of {all current month's ADU squared} minus (Mean squared times sum of {all last month's ADU squared}) divided by (Total Meters minus 1).

20 →

Step 2: Take square root of Step 1

3.3.2.1.5. Calculate high and low range factors.

Calculate high and low range factors (HRF and LRF) for each of the 3 usage ranges within a geographic area. The mean is used to calculate estimated reads, and the high and low range factors are used in this validation check. 2.8 and 3.5 are used in the below example to represent the range deviation factor and will allow for an appropriate meter read error rate. This factor can be changed to control the error rate.

21 → High Range Factor Formula:
HRF = 1 + {(2.8X Modified Standard Deviation X Number of meters) / (Sum of Current month's ADU)}

22 → Low Range Factor Formula:
LRF = 1 - {(3.5 X Modified Standard Deviation X Number of meters) / (Sum of Current month's ADU)}

3.3.2.2. As each meter is read, perform the following using the values calculated from the previous meter reading days' data.

23 → 3.3.2.2.1. Determine the usage from the preceding billing month and the preceding billing reading for the customer and site.

24 → 3.3.1.2.2. Calculate low limit for this month's usage by multiplying the preceding month's usage by the low range factor determined above.

25 → 3.3.2.2.3. Calculate high limit for this month's usage by multiplying the preceding month's usage by the high range factor determined above.

26 → 3.3.2.2.4. If the current usage is between the low and high limit calculated in the previous two steps, the data passes the High/Low check.

4.1. Estimating Usage

4.1.2. Method 2 - Based on historical usage and similar customers

4.1.2.1. For the residential meter population (i.e., same geographic area and customer class), utilize the following determinants as determined in 3.3.2:

- ADU Low Range Factor (3.3.2.1.3.4)
- ADU High Range Factor (3.3.2.1.3.4)
- Low Range Modified Mean Factor (3.3.2.1.4.1)
- Medium Range Modified Mean Factor (3.3.2.1.4.1)
- High Range Modified Mean Factor (3.3.2.1.4.1)

27 → 4.1.2.2. Calculate the ADU from last month's billing period for that customer.

28 → 4.1.2.3. Calculate the modified ADU for a specific meter by multiplying last month's ADU (from step 4.1.2.2) by yesterday's medium range modified mean factor (above) for that geographical area.

29 → 4.1.2.4. Determine if the modified ADU is in yesterday's low, medium, or high range.

- If the modified ADU is less than the ADU low range factor, yesterday's low range modified mean factor is used to calculate estimated ADU in the succeeding steps.
- If the modified ADU is equal to or greater than ADU low range factor but less than the ADU high range factor, yesterday's medium range modified mean factor is used to calculate estimated ADU in the succeeding steps.
- If the modified ADU is greater than or equal to the ADU high range factor, yesterday's high

range modified mean factor is used to calculate estimated ADU in the succeeding steps.

30 → 4.1.2.5. Multiply the prior ADU by the modified mean factor determined in 4.1.2.4. This becomes the new estimated ADU.

4.1.2.6. Continue with steps 4.1.1.2, and 4.1.1.3 using the estimated ADU calculated in the preceding step.

ARIZONA VALIDATING, EDITING, AND ESTIMATING (VEE) MONTHLY AND INTERVAL DATA -DRAFT

Spreadsheet Calculations:

of Meters 19
# of Days in Month 30

Meter Number	Current Usage	(1) Current ADU	Last Month Usage	(3) Last Month ADU	Meter Reading	(4) Current ADU * Last Month ADU	(2) Current ADU Squared	(5) Last Month ADU Squared	(6) Range Grouping
1	125	4.17	135	4.50	3731	18.75	17.36	20.25	Low
2	275	9.17	250	8.33	7475	76.39	84.03	69.44	High
3	114	3.80	142	4.73	3697	17.99	14.44	22.40	Low
4	178	5.93	165	5.50	4888	32.63	35.20	30.25	Medium
5	254	8.47	260	8.67	7358	73.38	71.68	75.11	High
6	299	9.97	189	6.30	6835	62.79	99.33	39.69	High
7	178	5.93	190	6.33	5278	37.58	35.20	40.11	Medium
8	158	5.27	136	4.53	4176	23.88	27.74	20.55	Medium
9	165	5.50	140	4.67	4329	25.67	30.25	21.78	Medium
10	235	7.83	255	8.50	7033	66.58	61.36	72.25	High
11	218	7.27	235	7.83	6500	56.92	52.80	61.36	High
12	110	3.67	119	3.97	3286	14.54	13.44	15.73	Low
13	98	3.27	105	3.50	2912	11.43	10.67	12.25	Low
14	85	2.83	129	4.30	3117	12.18	8.03	18.49	Low
15	169	5.63	110	3.67	3913	20.66	31.73	13.44	Medium
16	200	6.67	168	5.60	5221	37.33	44.44	31.36	High
17	147	4.90	178	5.93	4688	29.07	24.01	35.20	Low
18	165	5.50	201	6.70	5281	36.85	30.25	44.89	Medium
19	180	6.00	135	4.50	4446	27	36.00	20.25	Medium
Sum		(7) 111.77		108.07		681.63	727.99	664.82	

Assume yesterday's ADU low range factor was 4.95 and the ADU high range factor was 6.4.

Mean (8) 5.88
Std Dev (9) 1.98
ADU Low Range Factor (10) 5.03
ADU High Range Factor (11) 6.73

Ranges	Low	High
Low	0	5.03
Medium	5.03	6.73 (12)
High	6.73	or higher

	(13) Meters	(15) Curr ADU	(14) Last mo ADU	(16) Curr * Last Mo ADU	(18) Curr Mo sqrd	(17) Last Mo ADU Sqd
Low	6	22.63	26.93	103.97	87.95	124.33
Medium	7	39.77	35.90	204.26	226.38	191.27
High	6	49.37	45.23	373.40	413.66	349.22

	(19) Modified Mean	(20) Mod Std Deviation	(22) Low Range Factor	(21) High Range Factor
Low	0.84	0.45	0.58	1.33
Medium	1.07	1.17	0.28	1.58
High	1.07	1.70	0.28	1.58

Example validation routine for meter read the following day using the determinants calculated above:

(23)
Customer's Last Month's Usage = 200 kWh ADU = 6.67 Customer's usage falls in Medium Range

High Range Value: 200 kWh X 1.58 = 316 (25)
Low Range Value: 200 kWh X 0.28 = 56 (24)

Usage falling between 56 and 316 is acceptable. Usage outside of this range fails the high/low usage check.

(26)

Example estimation routine for meter read the following day using the determinants calculated above:

(27)
Customer's Previous Usage = 200 kWh ADU = 6.67

Modified ADU = 6.67 X 1.07 (Medium Range Modified Mean Factor)
(28) = 7.14 Modified ADU

(29)
Determine where 7.14 is grouped according to the ADU low and high range factors (5.03 & 6.73 respectively)
7.14 > 6.73, therefore, the high range modified mean factor of 1.07 is used.

ADU Estimated usage = last month's ADU (6.67) X 1.07 = 7.14, rounded to 7
Total usage = ADU Estimated usage X number of days in the billing period. (30)

Arizona:

14. The rules approved by the Director, Utilities Division will be used by the Meter Reading Service Provider for validating, editing, and estimating metering data.

PENNSYLVANIA	**None**
Nevada = CUBR	**Insignificant**

Illinois

2. Data Validation, Editing, and Estimation. At this time, there are no national standards for data validation, editing, and estimation. Until such time as a national standard is developed, the following requirements provide the market with standard principles for performing the Validation, Editing, and Estimation (VEE) process. These requirements ensure that all Metering Parties utilize similar checks and estimation methodologies. A detailed procedural guide is included as Exhibit 1 as an example of one methodology that is fully compliant with the principles below. Other procedures, including the Utility's legacy methodology, should be allowed insofar as they satisfy the requirements defined herein.

The MSP shall retain documentation of procedures used for presentation during an audit. Additionally, the MSP shall provide the procedures upon request to a customer, Supplier, Utility, or the applicable regulatory authority. In the event the applicable regulatory authority determines one detailed set of procedures be adopted, the procedures in Exhibit 1 could be utilized as the statewide standard; however, the parties should be able to determine how they will validate, edit, and estimate as long as the following principles are met.

a. The following data validation tests are required for kWh and kVARh (if used in billing) interval data validation:

(1) Time check of meter reading device/system: compare to a standard that is traceable to a national standard time source. Accuracy tolerances shall be +/- 3 minutes. Such check should occur before data collection for the day begins. This check shall be performed by the MSP.

(2) Time check of meter: compare to a traceable standard. Accuracy tolerances shall be +/- 3 minutes. This check shall be performed by the MSP.

(3) Pulse overflow check: verify that number of pulses does not exceed maximum. This check shall be performed by the MSP.

(4) Sum check: verify that sum of intervals equals total consumption. This check shall be performed by the MSP.

(5) Spike check: check for usage spikes. This check shall be performed by the MSP.

(6) High/low check: check for too low or too high consumption. Check should utilize average daily usage for billing month one year prior.. This check shall be performed by the MSP based on 13 months usage history provided at the time the customer account is transferred and maintained thereafter.

(7) Meter identification check: verify meter identification number when reading. This check shall be performed by the MSP.

b. The following tests are required for monthly data validation:

(1) High/low usage check: check for too low or too high consumption. Check should utilize consumption for billing month one year prior. This check shall be performed by the MSP.

(2) High/low demand check (applies to demand readings only): check for too low or too high demand. Check should utilize demand readings for billing month one year prior. This check shall be performed by the MSP.

(3) Time-of-use check (applies to TOU data only): verify that sum of usage by time period equals total consumption. This check shall be performed by the MSP.

(4) Time check of meter where applicable (TOU meters): compare to a traceable standard. Accuracy tolerances shall be +/- 3 minutes. This check shall be performed by the MSP.

(5) Zero consumption for active meters: validate data if no consumption shown for active meter. This check shall be performed by either the MSP or the MSP.

(6) Meter reading dial/digit quantity: verify that number of dials/digits reported is same as number of dials/digits on meter display. This check shall be performed by the MSP.

(7) Dial decimal quantity: verify number of decimal places displayed on meter is correct (applicable for on-site reads only). This check shall be performed by the MSP.

(8) Meter identification: verify meter identification number when reading. This check shall be performed by the MSP.

c. Irregular Usage Customers. An irregular usage customer is one whose usage pattern does not follow normal usage patterns and consistently fails the spike check, kVARh check, or high/low usage check. A customer may be identified as an irregular usage customer by its MSP if:

(1) The customer data fails the standard validation check for three consecutive months and the MSP verifies that the data represents the actual customer usage or the MSP is notified by the customer's Supplier or previous MSP of the irregular usage pattern.

(2) If a customer has been identified as an irregular usage

customer, the MSP must notify both the Supplier and the Utility. Standard validation tests may then be modified based on the customer's usage pattern.

d. Data Estimation. Data estimation is required when an actual meter read is not available or data has been determined to be invalid. The following data estimation rules are required for cumulative data estimation:

(1) Use historical data for same customer at the same location; use rate class data if historical data for same customer is unavailable.

e. Data Estimation. Data estimation is required when an actual meter read is not available or data has been determined to be invalid. The following data estimation rules are required for interval data estimation:

(1) When less than two (2) hours is missing: use straight-line interpolation.

(2) When more than two (2) hours is missing: use historical data for same customer at same location; use rate class data if historical data for same customer is unavailable

New York

C. Data Validation, Editing and Estimation

1. Data Quality

(a) Clocks in time based meters may be maintained on local time in any time zone but must be synchronized to within +/- three (3) minutes of the National Institute of Standards and Technology (NIST).

(b) Usage data will be supplied as measured by metering devices unless otherwise indicated.

(i) Data known to be inaccurate or missing will be replaced with an estimate and flagged appropriately.

(ii) If a customer reads his own meter, it must be flagged as Customer Read.

(c) The MRSPMRSP shall retain documentation of all procedures used for VEE. These procedures must be made available to the following:

(i) An entity performing an audit
(ii) A customer
(iii) An ESCO
(iv) A utility
(v) Staff

2. Data Validation Requirements

(a) The following tests should be made by the MRSPMRSP to validate revenue cycle data:

(i) High/low usage check: check for too low or too high consumption. Check should utilize consumption for billing month one year prior.

(ii) High/low demand check (applies to demand readings only): check for too low or too high demand. Check should utilize demand readings for billing month one year prior.

(iii) Time-of-use check (applies to TOU data only): verify that sum of usage by time period equals total consumption.

(iv) Time check of meter where applicable (TOU meters): compare to a traceable standard. Accuracy tolerances shall be +/- 3 minutes. This check may be performed by the MRSPMRSP during data processing or during retrieval of the data manually.

(v) Zero consumption for active meters: validate data if no consumption shown for active meter.

(vi) Meter reading dial/digit quantity: verify that number of dials/digits reported is same as number of dials/digits on meter display. This check must be performed during a manual retrieval of meter data.

(vii) Dial decimal quantity: verify number of decimal places displayed on meter is correct (applicable for on-site reads only). This check must be performed during a manual retrieval of meter data.

(viii) Meter identification: verify meter identification number when reading. This check can be performed during a manual retrieval of meter data or through an automated communications link.

(b) The following checks must be made by the MRSPMRSP to validate interval data for energy or reactive quantities:

(i) Time check of meter reading device/system: compare to a standard that is traceable to a national standard time source. Accuracy tolerances shall be +/- 1 minute. Such check should occur before data collection for the day begins.

(ii) Time check of meter: compare to a traceable standard through an automated meter reading system. Accuracy tolerances shall be +/- 3 minutes.

(iii) Pulse overflow check: verify that number of pulses in each interval does not exceed maximum.

(iv) Sum check: verify that sum of intervals equals total consumption.

(v) Spike check: check for usage spikes.

(vi) High/low check: check for too low or too high consumption. Check should utilize average daily usage for billing month one year prior.

(vii) Meter identification check: verify meter identification number when reading.

(c) Irregular Usage Customers. An irregular usage customer is one whose usage pattern does not follow normal usage patterns and consistently fails the spike check, kVARh check, or high/low usage check.

(i) A customer may be identified as an irregular usage customer by its MRSP if the customer data fails the standard validation check for three consecutive months and the MRSP verifies that the data represents the actual customer usage or the MRSP is notified by the responsible ESCO or utility of the irregular usage pattern.

(ii) If a customer has been identified as an irregular usage customer, the MSDP must notify both the ESCO and the utility.

(iii) Both the ESCO and the utility maintain the right to reclassify the customer as not having irregular usage.

(d) Standard validation tests may be modified based on the customer's usage pattern. These modifications should be approved by all parties before being applied.

3. Data Editing Requirements

Some data errors, such as missing readings, missing digits, consumption outside of the range of possible use, communications errors, etc. may be detected during data retrieval and processing.

(a) The MRSP will be responsible for examining retrieved metering data, detecting errors or missing data, and resolving those errors where possible.

(b) Resolution of discrepancies that are under the control of the MRSP will be reached within 10 days.

(c) Once resolved, corrected data must sent to the appropriate entities on that day.

(d) If the MRSP can not directly resolve the discrepancy within the allotted time frame, it will:

(i) Provide an estimate of the data
(ii) Submit a request for investigation to the ESCO and utility.

(e) Investigation of unresolved discrepancies will be the responsibility of the ESCO.

(i) The investigation must be completed within 10 days.

(ii) Where utility involvement is required, arrangements must be made in accordance with the Access/Coordination/Timing Section of this document.

(iii) Configuration updates based on resolving an investigation should be provided to all parties within the timeframe of the investigation.

(f) Issues not under the direct control of the ESCO or utility may require additional time for resolution.

(i) Telephone line failures are an example of this type of issue.

(ii) In these cases, the ESCO and the utility must be notified of the delay and the expected resolution date.

(ii) Resolution of discrepancies shall be reached within 10 days of the resolution of the issue not under ESCO or utility control.

4. Data Estimation Requirements

Data estimation is required when an actual meter read is not available or data has been determined to be invalid.

(a) Cumulative readings may be estimated based on historical data for that customer at the same location or on rate class data if historical data for that customer is unavailable.

(b) Interval data may be estimated according to the following:

(i) When less than two (2) hours is missing use straight-line interpolation.

(ii) When more than two (2) hours is missing use historical data for that customer at same location or use rate class data if historical data for that customer is unavailable