ARIZONA INTERVAL DATA VALIDATING, EDITING, AND ESTIMATING (VEE) RULES AND PROCEDURES

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1. Introduction

This section defines the interval data validation, editing, and estimation techniques required to participate as an MRSP. Arizona VEE Rules will be reviewed periodically for any changes, adjustments or modifications.

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 to not reflect actual usage.

These rules apply to both kWh and kVARh data, depending on the data required by the customer's tariff(s). If data is provided for informational purposes only (not used for billing purposes), validation is not required. Data that has not gone through the validation process is raw data.

General MRSP's and MSP's business practices should ensure that the meter is programmed correctly for the required revenue data and that the MRSP's system is set up to accurately maintain information such as interval size, meter constants, and what quantity is recorded by what channel. These VEE rules do not require or describe how the MRSP verifies that the meter is programmed correctly.

All validation checks must be run. Failure of one check does not preclude the MRSP from performing other validation checks.

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Several words are used to describe the quality of interval data.

- Raw data - data that has not gone through the VEE process
- Valid data - data that has gone through all required validation checks and either passed them all or been verified
- Invalid data – data that has gone through all required validation and has failed some or all checks or has not been verified.
- Verified data - data that failed at least one of the required validation checks but was determined to represent actual usage
- Estimated - data that has been calculated based on standard estimation rules because the raw data was not valid or available
- Adjusted – data that has been changed because of an incorrect pulse multiplier.
- Editing – process used to change raw data by estimation or adjustment to correct usage.
- Reasonable data - data closely resembling projected data modeled by historical data, or the customer's load profile.

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The following validation checks are required for interval kWh and kVARh data. They are described below in section 3

Check	Purpose	Requirement
Time check of meter reading device/system	Check for the following: • Time drift of meter reading device/system outside the Applicable Regulatory Authority standard	Time of read
Meter identification check	Check for the following: • Meter ID was reported correctly • Meter has not been changed out • Data is being reported for the correct meter	Time of read
Time check of meter clock device system	Check for the following: • Time drift of meter clock outside the Applicable Regulatory Authority standard	Time of read
Pulse Overflow check	Check for the following: • Improper scaling factor in meter • Improperly sized transformer • Hardware problem	Time of read
Test Mode check	Check for the following: • Data collected when meter was in test mode that represents test load rather than actual usage	Time of read
Sum check	Check for the following in combination meter/recorder installations: • Crossed channels between meter and recorder • Pulse relay problems Check for the following for all installations: • Invalid VT and CT ratios, • Invalid meter constants	Monthly (Time of read Optional)
Spike check	Check for the following for all installations: • Transmission error • Spike resulting from meter test. Note that a spike can also occur after an outage - in this case the data is valid, but may or may not be used for peak billing depending on the tariff and company policy.	Time of Read (24-hour period)
kVARh check (for kWh data only if corresponding kVARh data available)	Check for the following: • KWh channels are correctly mapped to kVARh channel • Meter is operating correctly	Monthly
High/Low Usage check	Check for the following in all installations: • Dropped phases • Inaccurate meter constants • Energy diversion • Fast/slow meters Also check for the following in combination meter/recorder installations: erratic pulse input to recorder	Monthly

3. Interval Data Collection and Validation Rules

If interval data is read more often than required for billing, checks need to be performed at different times in the process. Some must be done as the data is read

from the meter; some can be done anytime between when the data is collected from the meter and the end of the cycle, and others have to be done on a billing period basis at the end of the billing cycle. They are broken out that way in this description.

3.1 Time check of meter reading device/system will be performed by the MRSP once every 24 hours to ensure that the collection device is synchronized to the national time standard

3.2 Collect data

3.3 As data is collected

3.3.1 Check meter identification – verify that the meter's identification matches what is expected. Any meter identification problem must be corrected prior to sending data.

3.3.2 Perform Time Tolerance check on meter and data.

The time tolerance check is performed to minimize and correct meter clock drift and to minimize and correct the data problems associated with meter clock drift.

3.3.2.1 Interval Check on data - How to do Time Tolerance check

To perform a time tolerance check on the data, compare the number of intervals retrieved from the meter to the number of intervals expected given the elapsed time.

Pass/Fail Criteria

- If the actual number of intervals is equal to the expected number, the data passes the time tolerance check.
- If the actual number of intervals differs from the expected number, the data fails the time tolerance (interval) check. The data to be corrected includes all intervals from the last time the meter time was determined to be good (i.e., within the 3-minute tolerance) and when it was discovered that the meter time was off by more than 3 minutes and the meter time was reset.

If data fails the Time Tolerance Check…

1) If the meter time was off by less than or equal to 15 minutes, a point to point linear interpolation shall be performed.

2) If the meter time was off by more than 15 minutes, the data must be estimated. See Estimation Rules – Section 4.

3.3.2.2 Synchronization Test - How to do Time Tolerance check on meter

To perform a time tolerance check on the meter, compare meter time to data collection device/system time. Note that depending on the communication technology used, network latency must be taken into account.

Pass/Fail Criteria

- If meter time is within 3 minutes of time standard, the meter passes the time tolerance check. (Note that if the meter time is within the 3-minute tolerance, the meter time may be corrected.)
- If meter time is off by more than 3 minutes, the meter time must be corrected. If the meter fails the time tolerance check for three consecutive months, the meter must be physically inspected/tested.

3.4 Either as data is collected or prior to publishing on MRSP Server

3.4.1 Perform Pulse Overflow check

Inspect each interval for this condition. If any instance of a pulse overflow occurs, the meter requires physical meter test/maintenance. Intervals with pulse overflows must be estimated.

3.4.2 Perform Test Mode check

Anytime the meter is placed in test mode and the actual data is not available, the data must be estimated (see Estimation Rules, Section 4.

3.4.3 Perform Sum Check

The sum check is performed on meters with encoded reads to ensure that the difference between the energy use recorded in the intervals and the energy use recorded in the meter over the same time period is within an acceptable range. This check may be done on either consumption or pulse data, provided the data scaling is consistent throughout the period.

How to do the Sum Check

1) Calculate the energy use recorded in the intervals by summing the intervals between the start and stop meter readings.

2) Calculate the energy use recorded by the meter by taking the difference between the start and stop readings accounting for possible rollover between start and stop readings. For example, if the start reading was 99968 and the stop reading was 00294, and the meter reading rolls over at 99999, the difference would be 326.

3) Compare the energy use recorded in the intervals to the energy use recorded by the meter. Note that the values must be in the same units for the comparison.

Pass/Fail Criteria

- If difference is <= 1.5 meter multipliers, the data passes the sum check. (meter multiplier = CTR x VTR x Dial Constant, where CTR is current transformer ratio, and VTR is voltage transformer ratio and Dial Constant is meter register multiplier)
- If difference is > 1.5 meter multipliers, the data fails the sum check.

If data fails the Sum Check

1) Steps to resolve the sum check failure will include one or more of the following procedures:

   (a) Reread the meter and redo the sum check from original start meter reading to new stop meter reading.

   (b) Redo the sum check, taking into account the differences 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. See Appendix A for more information.

(c) Redo the sum check, taking into account missing or incomplete intervals. See Appendix A for more information.

(d) Additional checks may be performed, based on the technology used, to verify that the interval data is an accurate representation of usage as measured by the meter readings.

2) If sum check is not resolved, perform manual inspection of data.

(a) Verify meter and pulse multipliers. If a multiplier was incorrect, redo the sum check using the correct multipliers.

(b) Check for a meter change between the start and stop meter readings. If the meter was changed, redo the sum check for each meter independently.

(c) Manually inspect data. If the data seems reasonable, it can be considered verified.

(d) If the data does not seem reasonable, perform physical meter test/inspection. If meter passes the physical test/inspection, the data can be considered verified. If a problem is found with the meter, the data must be estimated. (Note: if the problem existed prior to this billing period, previously posted data must be adjusted and re-posted.) If unable to visit site and perform meter test prior to posting the data, the data must be estimated.

(e) If interval data is available but meter readings are not available, manually inspect the data. Data that seems reasonable (compared with historical data) can be considered verified. Any data that does not seem reasonable must be estimated.

3.4.4 Perform Spike Check

The spike check is performed to identify intervals with questionably high usage relative to the surrounding intervals. This check may be done on either consumption or pulse data, provided the data scaling is consistent throughout the period.

How to perform daily Spike Check

1) For each 24-hour period, identify the highest and sixth highest peaks. (Normally the 24-hour period is from midnight to midnight. If the data is at the beginning of the span and doesn't start at midnight, use sufficient consecutive data from the next day of data to get 24 hours of data. If the data is at the end of the span and doesn't stop at midnight, use sufficient consecutive data from the previous day of data to get 24 hours.)

2) If the highest peak is less than or equal to the spike check threshold of 10 pulses, skip the spike check. (A spike check threshold is used to eliminate false spikes for meters with very low usage.)

3) If the highest peak is greater than the spike check threshold of 10 pulses, divide the highest peak by the sixth highest peak.

Pass/Fail Criteria

- If highest peak divided by the sixth highest peak is <= 1.8, the interval passes the spike check.
- If highest peak divided by the sixth highest peak is > 1.8, the interval fails the spike check.

If data fails the Spike Check

1) Reread the meter, when appropriate. If you get a different value from the reread, redo spike check.

   a) If value is the same on reread or you cannot reread the meter, perform manual inspection of data.

   b) Look for similar patterns on similar days. If a similar pattern is found and this seems reasonable, the data can be considered verified.

   c) Check with customer for unusual conditions at the time of the spike. If a legitimate reason for spike is found, the data can be considered verified.

2) If no similar pattern or legitimate reason for spike is found, the interval with the spike must be estimated.

3) If there is a regular pattern of failing this check, the customer may be an irregular usage customer. See section on Irregular Usage Customers for additional information.

3.4.5 If interval kVARh data is available, perform kVARh Check

The kVARh check is performed to identify intervals where reactive load (kVARh) is present and active load (kWh) is not, indicating a questionable usage pattern and possible meter malfunction. This check is only required when both kWh and kVARh are used for billing. If kVARh data is available but not used for billing, the check is optional. This check may be done on either consumption or pulse data, provided the data scaling is consistent throughout the period.

How to do the kVARh Check

1) If multiple kWh channels map to a single kVARh channel, or multiple kVARh channels map to single kWh channel, the appropriate channels must be totaled prior to this check.

2) If there are any kWh intervals with zero consumption, check the corresponding kVARh interval.

Pass/Fail Criteria

- If the corresponding kVARh interval is also zero or less than or equal to the kVARh check threshold of 10 pulses, the kWh data passes the kVARh check. (A kVARh check threshold is used to eliminate false errors for meters with very low usage.)
- If the corresponding kVARh interval is greater than the kVARh check threshold of 10 pulses, the kWh interval fails the kVARh check.

If data fails the kVARh Check

1) Steps to resolve the sum check failure will include one or more of the following procedures:

   (a) Investigate to determine if this data represents actual customer usage, in which case the data can be considered verified.

   (b) If multiple kWh channels map to a single kVARh channel, investigate to determine if the problem can be directly traced to specific kWh channels. If this is the case, only data for those channels must be estimated. If the problem is not attributable to specific channels, all kWh channels need to be estimated.

2) If no legitimate reason for the kVARh failure is found, the intervals with failures must be estimated.

3) If there is a regular pattern of failing this check, the customer may be an irregular usage customer. See section on Irregular Usage Customers for additional information.

3.5 On the billing cycle for the meter

3.5.1 High/Low Usage Check

This test must be performed on the data that has passed or been verified for previous checks, with no estimated values included. This identifies metered usage that is questionably high or low relative to historical usage. It may be performed on all data (valid and estimated) to provide a reasonableness check on the estimates derived using the standard estimation techniques.

This check must be done on consumption data, not pulses.

How to do the High/Low Usage Check

1) If last year's data is available, calculate average daily usage for same billing month last year; use summed VEE or historical billing interval data if available, if not use VEE or historical billing usage (i.e., difference between register readings).

2) If last year's data is not available, calculate average daily usage for the previous billing month; use summed VEE or historical billing interval data if available, if not use VEE or historical billing usage (i.e., difference between register readings).

3) If last year's data and last month's data are not available, skip the high/low usage check.

4) Calculate average daily usage for this billing month using either summed VEE data (if check includes estimated data) or sum of all intervals not requiring estimation (if check does not include estimated data). If not all intervals are included in the sum, prorate the sum accordingly.

Pass/Fail Criteria

- If this month's daily average is within 75 to 125% of the historical daily average, the data passes the high/low usage check. Any value outside this parameter fails.

If data fails the High/Low Usage Check

1. Check to see if there has been a meter exchange.

2. Check to ensure that the meter and pulse multipliers are correct.

3. Perform manual inspection of data.

   (a) Look at recent history for the meter. If monthly usage has been on a trend in the appropriate direction and this appears reasonable, the data can be verified.

   (b) Optionally check with customer for changed usage patterns. If changed usage patterns match change in data, the data can be verified.

   (c) Check to see if some of the data appears reasonable. For example: it may be possible that a meter failed sometime during a month, so that the data from the beginning of the month is valid, while data after the meter failure is invalid.

   (d) If the data does not seem reasonable, perform physical meter test/inspection. If meter passes the physical meter test/inspection, the data can be verified. If a problem is found with the meter, the data must be estimated. (Note: if the problem existed prior to this billing period, previously posted data must be adjusted and re-posted.) If unable to visit site and perform meter test prior to posting the data, the data must be estimated.

4) If the data is investigated and found to be accurate, the data is verified.

5) If the data fails the high/low usage check, suspect data must be estimated.

6) If there is a regular pattern of failing this check, the customer may be an irregular usage customer. See section on Irregular Usage Customers for additional information.

3.6 After all validation checks have been performed and required data has been estimated, the MRSP must rerun all validation checks to ensure reasonableness of estimates. If data fails validation after estimation, it needs to be manually verified for reasonableness.

3.7 Record Keeping Requirements

The data and the logs must be kept for a period of three years. If data failed one or more validation checks, the specific checks that the data failed must be recorded on an interval level, and:

1) If the data was manually verified, that information must be recorded on an interval level. Verified data represents actual usage.

2) If the validation failure(s) were not resolved through accepted methods, the data must be recorded as estimated.

For each interval that is estimated, the MRSP must record the estimation algorithm used. Interval data estimation algorithms include:

- less than 2 hours (4.1)
- greater than 2 hours (4.2) – scaled based on usage
- intervals adjusted
- intervals manually estimated
- intervals estimated due to meter interval programmed incorrectly

3.8 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. An MRSP can identify a customer as an irregular usage customer if:

1) the customer's data fails the standard validation check for three consecutive months and the MRSP verifies that the data represents the actual customer usage, OR

2) the MRSP is notified by the customer's ESP or previous MRSP of the irregular usage pattern.

The data used to identify an irregular usage customer could be data collected by the MRSP, or historical data provided by the previous ESP or MRSP. An MRSP may modify the spike check and/or high/low usage check, and skip the kVARh check if an irregular usage customer consistently fails the check. The MRSP must notify both the customer's ESP and UDC of the customer's irregular usage status and what modified checks will be performed immediately.

The goal of the modified checks is to automate the manual procedures the MRSP would perform to verify that this is the customer's normal usage pattern. An MRSP may use a variation of the spike check or high/low usage check based on the actual usage pattern. Note that the MRSP may not skip the spike check or high/low usage check. If the data passes the

modified check, the data is valid and does not need to be marked as verified.

- Examples of modifications for the spike check include modifying the spike check value (180%) or the pulse threshold value (10 pulses).
- Examples of modifications for the high/low usage check include changing the percentages (+/- 50%), using the year's average instead of one billing period's average, or comparing to the minimum and maximum values for the past year.

For some customers, irregular usage patterns are symptomatic of the business and will always be present, such as co-generation 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 customer. Temporary irregular usage customers must be reviewed annually to determine if they are still irregular usage customers or should be returned to the normal checks.

4. Interval Data Estimation Rules

A customer's bill is considered estimated when 10% or more of intervals are estimated in a billing period. (NOTE: It is the responsibility of the MRSP to flag each instance of an estimated interval on the Arizona 867 data file.)

Estimate intervals needing estimation using the following estimation rules;

4.1 If section of data needing estimation is 2 hours or less in length, use point-to-point linear interpolation to estimate the data. Intervals containing a power failure cannot be used as end points for interpolation.

How to apply Point-to-Point Linear Interpolation

1) If the section occurs in the middle of the data, the "first point" is the last valid interval before the section, and the "second point" is the first valid interval after the section.

2) If the section occurs at the beginning of the span, use the last interval from the historical data as the first point if the historical data is available and valid. Otherwise, use the second point (the first valid interval after the section) as the first point – this will cause the load to be estimated as a flat load.

3) If the section occurs at the end of the span, use the first point (the last valid interval before the section) as the

second point – this will cause the load to be estimated as a flat load.

4.2 **If the section of data needing estimation is more than 2 contiguous hours, use a scaling methodology to spread the kWh over selected reference days to estimate the data.**

Determine the amount of kWh (X) for the section of data needing estimation.

- If the dial reads are good for the bill cycle, use them to compute the total kWh for the bill cycle. To compute the amount of kWh (X) for the section of data needing estimation: X = total kWh for the billing cycle minus the summation of kWh for the good intervals
- If the dial reads do not include enough kWh to include the missing portion of the interval data, then the kWh for the missing portion or the section needing estimation should be estimated.
- If the timeframe of data needing estimation exceeds 24 hours, then check with the UDC *(if applicable)* to be sure there wasn't an outage, and/or check with the MSP to find out what happened to the meter and check with the customer to be sure that they were operating normally during the time when the interval data is missing or needs estimation.
- Estimate the kWh for the missing data or timeframe needing estimation using the average daily kWh from the current bill cycle if available or the average daily kWh for the billing cycle from the previous year, same bill month or the average daily kWh for the billing cycle from the same year, previous month or one of these values modified to account for current weather conditions and customer operating patterns.

Determine the reference days.

- The goal is to select reference days whose load shapes will most closely resemble the timeframe needing estimation.
- Select days closest in time. If none are available that would be appropriate, try the same seasonal group of months. If none are available that would be appropriate, try the same time frame in the previous year.
- Seasonal months are: Fall (September 15 through November 15)
  Winter (November 16 through February 15)
  Spring (February 16 through May 15)
  Summer (May 16 through September 14)

These seasonal dates are for the purpose of conducting VEE and are not intended to supersede any dates established for customer billing

purposes. These dates do not supercede any dates established by the ACC.

- Select "same weekdays" (Mondays for Mondays, Tuesdays for Tuesdays) when possible. If not enough are available, use "like days" (weekdays for weekdays, weekends for weekends).
- If a holiday falls in the estimation period and the customer observes that holiday, then use a holiday load shape as a reference day. If no holidays are available and the customer's holiday usage is similar to his Sunday usage, substitute a Sunday for the holiday. If the customer does not observe the holiday, use the appropriate "same weekday".
- If the estimation period exceeds one week, try to have at least one week of reference days.

Allocate the kWh for the estimation period.

- If the reference period includes multiples of the "same weekdays", average them together to create an average Monday, Tuesday etc.
- Place the reference days into the portion of the file to be estimated.
- Sum the kWh (Y) of the estimated (reference days) portion of the file.
- Take the kWh calculated for the section needing estimation and divide it by the sum of the kWh in the reference days. **Scale factor=X/Y**
- Multiply every interval in the estimation period by the scale factor.

The maximum demand for the bill cycle should not be estimated, unless the entire cycle is estimated. In this case, use historical data to define the maximum demand.

4.3 Correcting data problems attributable to metering problems

Rules for assigning the file status and individual interval status

If on investigation the cause of the data problem is determined to be a problem with the meter or meter installation use the following rules to correct the data by scaling or estimating the intervals or the meter reads.

4.3.1 In the case of an incorrect pulse or meter constant being applied to the data, the MRSP will be notified of the following:

1. The time period requiring action.
2. The correct pulse or meter constant.

Without prior knowledge of a problem

- For the **Original** data file, if the intervals were sent prior to having any knowledge that the meter data was incorrect, the intervals would be marked as **Actual**.
- Any subsequent corrections will result in the new file being marked as **Corrected** and each affected interval marked as **Adjusted**.

With prior knowledge of a problem

- For the **Original** file, if there was prior knowledge that the meter interval was incorrect and corrections are made by applying the correct pulse constant to each of the affected intervals and the intervals would be marked as **Actual**.
- Any subsequent corrections will result in the new file being marked as **Corrected** and each affected interval being marked as **Adjusted**.

4.3.2 In the case of the meter being programmed incorrectly, wired incorrectly causing the meter to run fast or slow or one or more phase being dropped, the MRSP will be notified of the time period requiring action.

Without prior knowledge of a problem

- For the **Original** file, if the intervals were sent prior to having any knowledge that the meter intervals were incorrect, the data would be marked as **Actual**.
- For any subsequent corrections the new file will be marked as **Corrected** and each affected interval will be marked as **Estimated**.

With prior knowledge of a problem

- For the **Original** file, if there was prior knowledge that the meter data was incorrect the file will be marked as **Original** and each affected interval will be marked as **Estimated**.
- For the **Original** file, if there was prior knowledge that the meter data was incorrect and corrections result in less than 10% of the total intervals being estimated, the file will be marked as **Original** and each affected interval marked as **Estimated**.
- For any subsequent corrections which result in the sum of the original and subsequent estimated intervals the exceeding 10% of the total intervals being estimated the new file will be marked as **Correct** and each affected interval marked as **Estimated**.

4.3.3 Interval in meter doesn't match tariff or settlement requirements

If the meter programming and the MRSP requirements are inconsistent, the data is calculated as follows and the meter program must be corrected immediately:

1) The meter is programmed to collect data at a smaller interval than required by its tariffs, and the meter's interval evenly divides into the interval required by the tariff – for example, the meter was programmed to collect 5-minute data, and the tariff requires 15-minute data. Sum the 5-minute intervals into 15-minute intervals on even 15-minute boundaries. If the data passed all the other validation checks, it is valid and does not need to be marked as estimated or verified.

2) The meter is programmed to collect data at a larger interval than required by the meter's tariff. For example, the meter is programmed to collect 60-minute intervals, but the tariff requires 15-minute intervals. Prorate the data by assuming an even load distribution during the interval. In this example, the usage in the 60-minute interval is divided by 4 to estimate the usage in a 15-minute interval. The data is marked as estimated. **The meter must be reprogrammed to the correct interval.**

3) The meter is programmed to collect data at a smaller interval than required by its tariff, but the meter's interval doesn't evenly divide into the interval required by the tariff. For example, the meter is programmed to collect 10-minute intervals, and the tariff requires 15-minute intervals. The data is estimated and marked as estimated. To estimate data, all collected intervals that are contained within the required reporting interval are included in the appropriate reporting interval. Collected intervals that cross the boundaries of required reporting intervals are included proportionally in both reporting intervals. In this example, if there are three 10-minute intervals containing 10 kWh, 20 kWh, and 30 kWh, the corresponding estimated 15-minute intervals contain 20 kWh (10 + 0.5*20) and 40 kWh (0.5*20 + 30). This is similar to the prorating technique discussed in Appendix A. **The meter must be reprogrammed to the correct interval.**

5. **Re-posting Data**

The MRSP will be required to re-post actual or corrected data regardless of the amount of usage or time that has elapsed since the posting of the original file.

It will be up to the discretion of the biller and/or settlement whether the data is used for rebilling.

6. **Totalized Meter Data**

The MRSP must post validated data for each sub-meter. It will be the responsibility of the UDC, or billing party, to totalize for billing purposes if this is required for the tariff. The MRSP will read the recorder and run all channels (sub-meter and totalized loads) through the Arizona Interval Data VEE Rules and Procedures process. Contact the UDCs for Terms and Conditions protocols regarding totalized meters.

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Appendix A:
Interval Data VEE Technical Methods

1. 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.

1.1 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:

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

(i) 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%.

(ii) 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.

(iii) 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).

(iv) 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.

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

(i) 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%.

(ii) 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.

(iii) 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.

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

(v) 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 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:

A. Count the number of good intervals in the data stream.

B. 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.

C. 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 1.1 in this step.)

D. 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.

E. If the difference is less than or equal to the allowable margin from 1.1, the good intervals pass the sum check. The missing or incomplete intervals need to be estimated.

2.0 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 Fact·- Total Estimated Usage/Sum of Estimated Intervals

6. Multiply each estimated interval by the scaling factor.