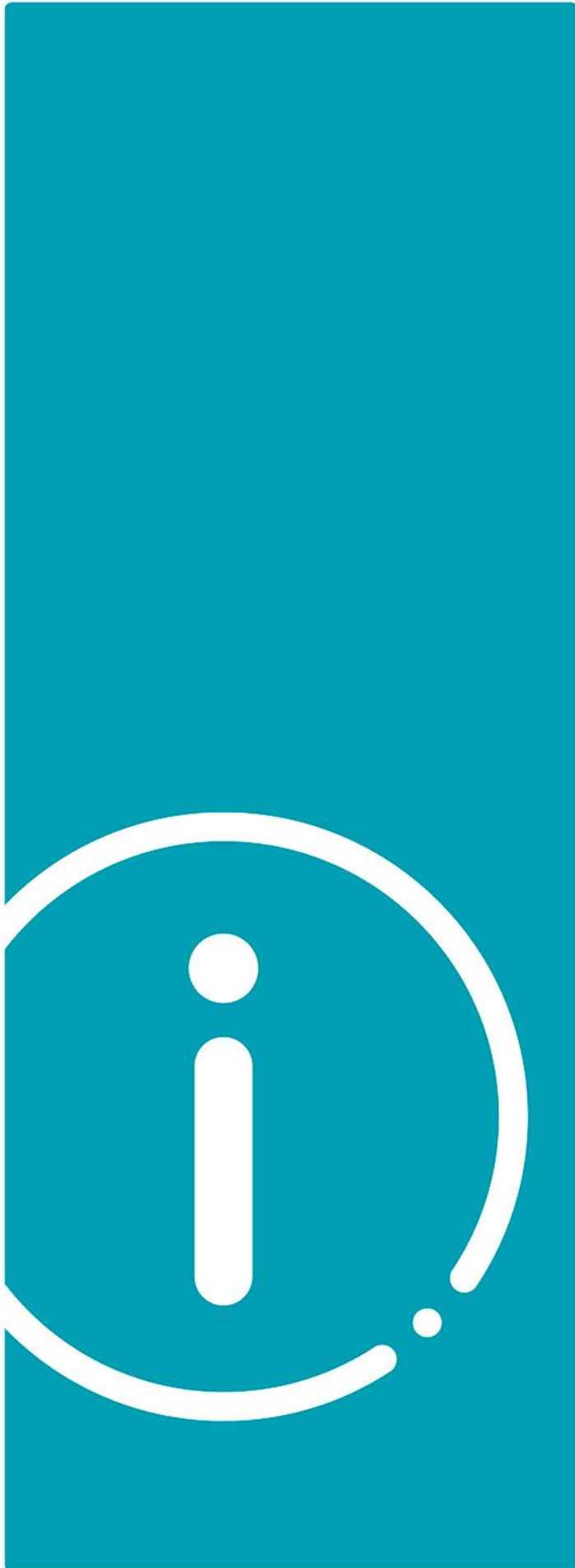




AMI Technical Specification

AMI/ALD Spec

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1. OVERVIEW

1.1 SUBMITTAL REQUIREMENTS

- A. Conformance to Specifications: The material and performance specifications described herein are intended to establish a desired standard of quality. The inability to meet all requirements does not constitute an automatic rejection of a proposal. **Proposer shall submit a list of all deviations from this specification as part of his Proposal.**
- B. Billing Integration: A description of proposed software and guarantee of compatibility with Owner's existing billing software shall also be provided.
- C. Operation and Maintenance Manuals: The Bidder shall provide operation and maintenance manuals for the complete system as a part of their proposal.

1.2 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations.

2. PRODUCTS

2.1 METER REQUIREMENTS

A. Quality Assurance

1. The equipment shall be manufactured by a reputable company with at least ten (10) years of experience in the manufacture of water meters and AMI systems.
2. The equipment shall be manufactured by a reputable company with at least thirty (30) years of experience in the manufacture of ultrasonic water meters.
3. All materials and equipment supplied under this Section shall be new, of good quality, and in good condition

B. Meter Construction

1. All water meters shall use ultrasonic measuring technology with no moving parts.
2. All sensors and electronics shall be designed so that they are fully protected against internal and external penetration of fluid.
3. The meters shall be hermetically and vacuum-sealed to prevent humidity from entering the electronics and avoid condensation between the glass and display.

C. Materials: Meters shall be made available in both 40% fiberglass reinforced Polyphenylene sulfide (PPS) or 316L Stainless Steel meter bodies.

D. Battery

1. The battery in 6" and larger meters shall be field replaceable with no need to take the meter out of service.
2. The meter shall provide a low battery warning on the display in accordance with AWWA C715 operating guidelines and be transmitted as an alert to the AMI system.

E. Measurement

1. Maximum permissible error shall fall in accordance to AWWA C715-18 operating guidelines $\pm 1.5\%$ in normal flow range and $\pm 3\%$ for low flow ranges.
2. Starting flows on 5/8" meters shall start measuring as low as 0.008 GPM.
3. Water meters shall have the ability to measure, log, and transmit the temperature of the water and ambient temperature over the AMR or AMI network.

F. Flow Validation: All meters shall have the ability to log a total of historic volumes by flow rate range to conduct a consumption profile for the installation.

G. Approvals, Certifications, Standards, and Ratings

1. The meter shall be approved according to Drinking Water Standards in multiple countries and certified to NSF/ANSI 61.

2. The meter shall fully comply with AWWA C715-18 guidelines.
3. The meter shall be IP68 type tested and able to operate fully submerged
4. All radio communications shall comply with relevant FCC rules, including Part 15. Meters shall have been tested by FCC to ensure that they meet requirements regarding EMC emissions and FCC ID shall be laser printed or permanently engraved on each meter.

H. Verification and Calibration: All meters shall be flow bench tested, verified, and calibrated by an accredited laboratory during production.

I. Distribution Acoustic Leak Detection

1. Meters up to 1" shall have the capability to monitor and record acoustic noise to enable distribution side leak detection.
2. The acoustic leak detection sensor and electronics shall be integral to the meter, requiring no external hardware or wired connections.
3. The acoustic data shall be captured and communicated regardless of reading method (AMR or AMI).
4. The acoustic functionality may be activated immediately at time of purchase or offered as an upgrade without requiring a field visit or reprogramming of the meter or affecting the warranty or battery life.

J. RF Communications Module

1. The meter and RF communication module shall be one single integrated unit hermetically sealed.
2. The meter shall be capable of communicating in both AMR and AMI modes.
3. AMR communications shall utilize an unlicensed 912.5-918.5 MHz frequency range.
4. AMI communications shall utilize an FCC assigned frequency within the licensed 450-470 MHz frequency range.

K. Data Logging

1. The meter shall store data logs in the internal memory. These logs shall be easily retrievable via a mobile app and displayed graphically in the headend system.
2. Data logs shall provide at least 460 days of daily interval readings, 100 days of hourly interval readings and the last 50 alarm info codes.

L. Data Options

1. To support configuration changes to leak, burst, temperature thresholds and transmission intervals, the meter shall allow reprogramming over the AMI network.
2. Firmware updates shall be permissible over RF without having to gain physical access to the meter and allow deployment in groups.
3. Standard data communication intervals shall be at least every three hours (eight times per day) delivering true hourly, time-synced, register values.

4. The meter shall be capable of delivering near real time events such as:
 - a. Continuous flow leak
 - b. Burst/ High Flow
 - c. Dry pipe
 - d. Reverse Flow
 - e. Tamper
 - f. Low Battery
 - g. Overflow: Indicating flow exceeded the rated maximum flow rate for the meter size.

M. Display

1. The meter shall include an easily readable LCD display including nine-digit resolution, unit of measure, billable digits, all active alarm codes (leak, burst, dry, reverse, tamper, low battery) radio off, and visual flow rate indicator.
2. Display resolution shall be configurable upon order and may be changed after shipment.
3. Meter serial number shall be barcoded and numerically visible on the register face, as well as meter size, FCC identification, NSF compliance, production year, and maximum operating pressure.

N. Security: All Data communicated over a radio network, AMR or AMI, shall always be encrypted.

O. Operation: The meter shall be able to operate accurately under a maximum pressure of 250 PSI for PPS meters and 300 PSI for Stainless Steel meters.

P. Check Valve: As an option, each 5/8" x 3/4" water meter may be supplied and installed with a spring- loaded check valve within the lay length of the meter body.

Q. Meter Warranties

1. Materials And Workmanship: The Seller warrants that the Products shall be free from defects in Materials and Workmanship during the Warranty Period defined as follows:

For Meters:

- a. 5/8"x1/2" – 1", the Warranty Period is a full twenty (20) years from the date of delivery to Buyer
- b. 1½" and larger, the Warranty Period is a full ten (10) years from date of delivery to Buyer.

2. Accuracy: Seller warrants that the Meters will perform to the accuracy as defined in AWWA C715-18 and to AWWA M6 manual. In case the Meters do not comply with the warranties the Seller shall repair or replace any defective Meter at no cost or refund the purchase price of such defective Meters:

For Meters:

- a. 5/8"x1/2" – 1", the Warranty Period is a full twenty (20) years from the date of delivery to Buyer
 - b. 1½" and larger, the Warranty Period is a full ten (10) years from date of delivery to Buyer.
3. Battery Life: Based on the operation of the Meters at an ambient operating temperature not higher than stated in the technical documentation, the warranty on the system battery in the Meter shall be for a period as follows:

For Meters:

- a. 5/8"x1/2" – 1", the Warranty Period is twenty (20) years (10 full/ 10 prorated) from the date of delivery to Buyer. Seller shall replace any Meters that contain defective batteries at a cost to Buyer equal to the price set out in the price list valid at the time of return of the Meter, minus the discount according to the following schedule:

Year	Discount	Year	Discount
11	75%	16	40%
12	75%	17	30%
13	50%	18	20%
14	50%	19	10%
15	50%	20	10%

- b. 1½" and larger, the Warranty Period is a full ten (10) years from date of delivery to Buyer.

2.2 DATA COLLECTOR REQUIREMENTS

- A. Configuration: Data collectors shall consist of a base box and top box. The base box shall allow up to four top box connections if the collector site installation requires.
- B. Built-In Network Intelligence: The AMI system shall automatically monitor and adjust the output power of the meter to allow the optimal radio performance of the system. The system shall select the optimal collector to read the meter, but in the event the collector is taken out of operation, other collectors shall provide network coverage redundancy.
- C. Data Storage: The collector onboard data storage shall support up to 25,000 meters and be able to store up to 30 days of hourly data.
- D. Communication: Data backhaul communication options shall include either cellular modem or ethernet network.
- E. Security: The data collector shall follow TLS 1.2 protocol with AES 256-bit encryption to the head end system.
- F. Physical: Collector shall be housed in a rugged NEMA 4, (IP66) enclosure class with built-in lightning protection.
- G. Operation: Collector shall operate from -22° F to 149° F. Power input 110 VAC 50/60 Hz.

- H. Solar Power Option: Collector shall offer an optional solar power input, available for an additional fee, to ensure functionality in locations where mains power is unavailable.

2.3 AMI NETWORK REQUIREMENTS

- A. The network shall allow for collector redundancy without the need for repeaters.
- B. The network shall automatically perform required updates such as firmware for the collector infrastructure without user intervention.
- C. The system network design shall achieve a 100% coverage of meter population.
- D. The system network design shall achieve a minimum of +98.5% daily reading performance over a 3-day billing read window.
- E. The AMI system shall be self-healing by automatically monitoring reading performance and adjust power output of meter transmissions.

2.4 AMI SOFTWARE REQUIREMENTS

- A. The software shall be a cloud-based solution. It shall include online help describing all menus and feature sets with step-by-step tutorials.
- B. Data Hosting: All data shall be hosted on multiple US based servers.
- C. Data Storage: Historical reading data shall be hosted for up to thirteen months for hourly data and five years for daily data.
- D. Billing Systems Integration: The software interface to and from Owner's billing software shall be flexible supporting with single record fixed width or delimited (CSV) file formats that can be customized to easily integrate to the billing system.
- E. File Scheduler: User defined custom data imports and exports shall have the ability to be scheduled as automatic jobs to an FTPS/SFTP server or email.
- F. Features
 - 1. The software shall have search capabilities to search all or specific fields such as address, meter serial number, account number, customer name, etc.
 - 2. The software shall be able to filter on meter rollovers and final readings.
 - 3. The software shall provide hourly readings, bar graph chart visualization of average flow per hour to easily identify trends, and anomalies and hourly, daily, monthly, yearly consumption over a user defined date range.
 - 4. The software shall be able to prioritize between high and normal priority codes and be able to schedule the frequency and time when the notifications are delivered or be able to send notifications when they are detected.
 - 5. The software shall allow the creation of meter groups automatically through imports or manually.

6. The software shall allow a user to perform meter exchanges, so that historical data may be referenced under the account with associated meter data history.
7. The software shall have consumption reporting capabilities by group and custom date range with filters higher or lower than configurable thresholds.
8. The software shall allow import and display of custom fields which also may be exported back to the CIS.
9. The software shall allow the reading to be displayed and exported as read from the meter, or in US gal, ft3, m3, l, Imp gal (Us Gallons, cubic feet, cubic meters, liters and Imperial gallons)

G. Fallback Mobile Drive-By Reading

1. The AMI software shall include the ability to read meters via AMR mobile drive by and AMI without installing additional PC software or add on module components.
2. The mobile drive by application shall support Android devices (smart phones or tablets). Data may be synchronized from the mobile app and host software at any time via Wi-Fi or cellular network without the loss of captured data.
3. In addition, if readings were missed by the fixed network system, it shall allow a data log of the meter to be sent back to the head end system so that it may be viewed in the software.

H. Mapping Visualization: The software shall have the ability to import GIS coordinates or be able to geocode by address, city and zip code via Google Maps. The meter may be viewed graphically in the host software and in the mobile application when in the field.

I. Performance Reporting: The software shall provide performance analytics to recognize data collection success of all meters or meter groups on user defined parameters such as daily or hourly reads as a percentage or number to monitor the health of the system.

J. Data Security and Integrity

1. Hosted data shall be stored in a SOC 2 or ISO 27001 certified environment including firewalls, antimalware systems and encryption for data protection.
2. Meter encryption keys are assigned to the utility to prevent unauthorized access to meter reading data. Data sent to the host software shall use TLS 1.2 protocol with AES 256-bit encryption.
3. The import of meter data shall prevent human data entry errors, prevent duplication of meter serial numbers, and distinguish between meters with integrated or separate endpoints.
4. The system shall enable the utility to assign and customize user access and permissions based on each user's role within the organization.

K. Acoustic Leak Detection Analysis

1. The software shall support the collection of acoustic noise data from integrated acoustic smart meters and automatically prioritize them based on customer defined levels.

2. The software shall be accessible via a web or mobile browser such as Google Chrome, Microsoft Edge, Internet Explorer and supported on mobile platforms (iOS, Android and Windows.)
3. The software shall graph acoustic noise trends over time and allow the user to select the desired date range.
4. The software shall visually display meters by noise level geographically in map view and allow customization of which meters are displayed or hidden.
5. The software shall support meter event tracking, leak type categorization, commenting, and final resolution reporting after field leak investigations.
6. The software shall provide auto-generated reports configurable by custom noise level and number of days.
7. The software shall provide a list view of meters with corresponding data including latest acoustic noise value, maximum value, average value, customer side meter alarms such as leaks, and bursts and latest reading date.
8. The software shall have the ability to assess meter flow conditions to determine if the leak may be before or after the meter.
9. The software shall provide the option to integrate a distribution pipe layer network to aid in visualization of meter locations in relation to distribution main lines and utility service lines.
10. The software shall be able to export data in CSV and PDF formats.

3. EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. All equipment, hardware, and software shall be installed in accordance with the manufacturer's recommendations.
- B. Meters
 - 1. All meter install locations shall be collected with high resolution GPS (3-foot minimum horizontal accuracy) along with all pertinent information including but not limited to service address, meter size, meter/radio identification numbers, and all other collectible attributes determined during project kickoff meeting(s). This data shall be transmitted to the Utility in shapefile and .xlsx file formats, at minimum. Proposed methodology for this data collection should be discussed in the proposal.
 - 2. The meter may be installed at any angle and position with no minimum straight pipe and meet applicable AWWA accuracy standards.
 - 3. When the meter is installed, the use of a mobile application shall confirm that the meters signal is being received by one or more AMI data collector and verify the signal strength to determine whether the installation is good before leaving the installation site.
- C. Data Collectors: The collector shall be plug-and-play without requiring programming. The collector's assigned radio frequency shall be automatically configured over the network without the need for user intervention.

3.2 QUALITY CONTROL AND FIELD TESTING

- A. Field Testing: The Proposer and the manufacturer's representative shall demonstrate to the Owner that the equipment operates as designed and specified.
- B. Training: The Proposer shall provide technical training and supporting documentation to the Owner.

3.3 SYSTEM SUPPORT

- A. The meter system supplier shall provide hardware/software support for any active software subscription.

END OF SECTION