CITY OF SEBASTOPOL
MEMORANDUM

Date: January 10, 2022

To: Lawrence McLaughlin, City Manager/City Attorney

From: Dante Del Prete, Public Works Superintendent

Subject: Energy Conservation Measures Summary

ENERGY CONSERVATION MEASURES SUMMARY
DETAILED SCOPE OF WORK

1, Install New Destratification Fans
The main hall at the Community Center has a high ceiling space where air temperature stratification causes occupancy comfort issues. By installing destratification fans in the space the average bulk air conditions will be more uniform creating a more comfortable space for occupants as well as be more responsive to the HVAC equipment conditioning the space. This will result in decreased energy use, specifically for heating.

Mechanical

- Install new destratification fans in gym rafter structure
- Install new electrical power circuits for fans
- Provide necessary engineering and project management for complete turnkey system
- Provide as built drawings, cut sheets/submittal package, O&M manual
- Provide owner/operator training

2, Generator Heat Pump Block Heater
The backup generator serving the Morris Street Sewer Lift Station utilizes an electrical resistance heating element to maintain the oil sump and block temperature for rapid start operations. This measure will replace this heating element with a heat pump heating system. This will utilize less energy to maintain the engine temperature.

Mechanical

- Remove existing electrical heating system electrical components and properly dispose of
- Provide and install heat pump heating element system, system controls and integration
- Perform system startup and confirm operation with generator

- Provide necessary engineering and project management for complete turnkey system
- Provide as built drawings, line-by-line audit, cut sheets/submittal package, O&M manual
- Provide owner/operator training

3, Replace Library HVAC Equipment on Roof

The library building has packaged HVAC equipment located in the mechanical well on the roof. This equipment is at the end of its useful life and beginning to be difficult to maintain and has significantly reduced energy efficiency. This measure will replace the existing systems with new electric heat pump systems eliminating the need for primary gas at the site. This measure will realize a full maintenance cycle on the HVAC equipment and improve the airflow efficiency and operation of the systems.

Mechanical
- Remove and properly dispose of existing RTUs in accordance with all state and local codes
- Remove and properly dispose of existing attic vents
- Provide and install new heat pump RTU's with minimum efficiency of 12.2 EER
    - If no natural gas backup heat selected, demo natural gas pipe back to roof penetration, valve off and cap
    - If electrical backup heat selected, provide and install new electrical feeder, circuit breakers and conduit for hookup

- Reuse existing equipment sleepers and provide and install new sleeper drip cap.
- Provide and install new isolation spring dampers for each unit
- Include crane pick and rigging
- Provide and install new attic vents
    - Modify curbs as needed to prevent water intrusion from new roof system

- Reconnect new RTUs to existing thermostat controls
- Provide pre and post air balancing to match existing air flows
- All new duct to be insulated in accordance with Title 24
- Provide and install new electrical disconnects and fuses
- Provide necessary engineering and project management for complete turnkey system
- Provide as built drawings, cut sheets/submittal package, O&M manual
- Provide owner/operator training

4, Install New On-Site Pool Chlorine Generator

Existing equipment has passed the end of its useful life and is showing significant signs of wear. The existing system continually increased the salt content of the pool water making managing

pool chemistry difficult and damaging to equipment. The new system is designed to reduce new salt introduction and more effectively control pool chemistry.

Mechanical

- Remove and properly dispose of existing on-site generation system, in accordance with all applicable codes
- Provide, install and start up new NEX-GENpH Generator
- Include all electrical disconnect and reconnect
- Include all chemical connections to feedstock and injection ports
- Provide necessary engineering and project management for complete turnkey system
- Provide as built line-by-line implementation audit, cut sheets/submittal package, O&M manual
- Provide owner/operator training

5, Lighting Efficiency & Controls Update

The existing lighting systems in the city buildings are generally a mix of original linear T8 fluorescent tubes, recessed can lights with 2 and 3 lamp CFL pin lamps and LED lighting. There are (16) sixteen city owned streetlights that are not LED. This measure will replace the existing lighting systems identified in the lighting audit with new LED lamps or fixtures as recommended. Additional controls will be integrated where identified. City Hall, Community Center, Corporate Yard, Fire Department, Ives Pool Complex, Police Department, Sebastopol Library, Senior Center, Youth Annex, Libby Park / Garzot Building, and Streetlights

Building Lighting

- Project per ECM Holdings line by line audit
- Disconnect and reconnect line voltage
- Coordinate working periods to minimize occupant impact
- Clean all work areas of debris and dust after lighting work is completed
- Dry wipe all new and remaining lighting surfaces to be free of dust and debris
- Provide necessary engineering and project management for complete turnkey system
- Provide as built line-by-line audit, cut sheets/submittal package, O&M manual
- Provide owner/operator training

Street Lighting

- Project per City provided GIS and streetlight line by line data
- Remove and properly dispose of existing fixture head
- Provide and install new LED cobra head in accordance with City of Sebastopol requirements
- Includes all crew, trucks, rigging, deployment equipment needed for installation
- Dry wipe all new and remaining lighting surfaces to be free of dust and debris

• Update any GIS or other data tracking required by City of Sebastopol to fully document update
• Ensure that all fixtures are working properly and turning off and on based on daylight
• Assist City with submission of documentation of fixture change to PG&E for rate tariff update
• Provide necessary engineering and project management for complete turnkey system
• Provide as built line-by-line audit, updated GIS or other tracking, cut sheets/submittal package, O&M manual
• Provide owner/operator training

6, City Water Meter Replacement

The existing domestic water meter system employed by the city for water use and billing is aging. All Residential meters that are 5/8"x3/4" and are 11 years or older will be replaced with new Badger E-Series ultrasonic meters. The balance of the existing water meter fleet will be retrofit with new digital dial registers. All meters, city-wide, will be fit with a cellular radio for consumption reporting. This meter consumption data transfer will occur periodically 4x throughout the day, reporting back to the billing system for logging. This will allow the city to monitor for leaks and be proactive in water management as well as to reallocate manpower from reading meters to other city projects. This will also allow the city to bill customers monthly. By replacing the exiting domestic water meters and fitting them with radios the city will be able to monitor for water leaks proactively, change the unit of measure for cubic feet to gallons and increase billing frequency from bi-monthly to monthly.

Implementation

• Perform city-wide pit / meter / lid survey and pit cleaning
• Provide and install 1,650 new 5/8"x3/4" Badger E-Series ultrasonic meters to replace existing meters 11 years and older across the city, with armor cable and twist lock connector
• Provide and install 1,352 retrofit register head from Badger with wired connection with armored cable and twist lock connector for radio connection on all meters not replaced
• Provide and install 3,002 new cellular radio connections to all meters, city-wide
• Provide and install new Badger approved radio transparent pit lids or accessory box and lids for all meter pits as required
• Coordinate new meter data transfer into billing system
• Coordinate working periods to minimize occupant impact
• Assume that all water shut off valves are functional
• Provide necessary engineering and project management for complete turnkey system
• Provide as built line-by-line audit, cut sheets/submittal package, O&M manual
• Provide Operator training

Additional Information

The product that has been ordered for Sebastopol is ORION Cellular.

This system leverages the public cellular network and requires no proprietary gateways to operate.

ORION Cellular water endpoints transmit 4x per workday – 3 times configurable by the City, and the 4th transmission is random.

ORION Cellular endpoints transmit 1x per weekend day.

The ORION Cellular endpoint ensures reliable, long distance data delivery at a maximum transmission power that is governed by the cellular standard, 23dBm **(0.20W).**

(See manufacturer attachments)

Security

ORION Cellular water endpoints broadcast a unique serial number, meter reading data, and applicable status indicators. As an advanced data security measure, each message is securely transported to the BEACON AMA software only via private network and never over the public internet.

Future Opt-Out Option

City staff is currently developing a program to support offering our customers a choice in metering infrastructure as a cellular Opt-Out option.

This program will support residential customers who prefer not to have the data collector/ transmitter installed with their water meter. The program will allow customers to have their meter read manually at the end of every month.

Warranty Information

Lead-Free Housings

Twenty (20) years and six (6) months after shipment from Badger Meter.

Electronics, Battery, Transducers, and Register/Encoder Supplied with the Meters Listed Herein

Twenty (20) years and six (6) months, prorated, after shipment from Badger Meter.

This warranty is prorated as follows: For the first ten (10) years of the warranty the Product is replaced at no charge, and the warranty is prorated at price discounts during the last ten (10) years of the warranty.

Specifically, Badger Meter will repair or replace, at its discretion, a non-performing Product at no cost during the first ten (10) years of the warranty and at prorated price discounts during the last ten (10) years of the warranty. Badger Meter will apply these prorated price discounts to the Product list prices in effect at the time of Product return and according to the following prorated price discount schedule:

Years 11 through 12—75% discount
Years 13 through 15—50% discount
Year 16—40% discount
Year 17—30% discount
Year 18—20% discount
Years 19 through 20—10% discount

Meter Accuracy

The Product will meet or exceed all applicable specifications outlined in AWWA Standard C715 in addition to meeting meter accuracy of ±1.5% for the published ranges set forth in Badger Meter's current published product data sheet for twenty (20) years from the date of shipment from Badger Meter.

Extended Low-Flow Accuracy

Badger Meter further warrants the Product will meet extended minimum test flow accuracy of ±3% for the published ranges set forth in Badger Meter's current published product data sheet for twenty (20) years from the date of shipment from Badger

7, Water & Wastewater Pumping Efficiency

The city produces and sells water to the residents via four (4) water production wells and a distribution network connecting reservoirs to the end consumers. There are two (2) wastewater lift stations that pump wastewater over hills and ultimately to the treatment facility located in Santa Rosa. The pumps at the Morris lift station are showing signs of decreased efficiency to move material from the wet well to the pipeline. This measure will replace the three (3) pumps with new and relocate to them to the pump room, removing the 2-story drive shaft system currently in place. Wells 6 and 8 are showing signs of reduced efficiency. By redeveloping and replacing well components the production efficiency may be increased. By replacing equipment and redeveloping wells, pumping efficiency may be increased to reduce the cost to produce water and remove wastewater. This will also realize a significant maintenance improvement at the sites.

Morris Lift Station

- Coordinate working periods to minimize occupant impact
- Assume that all water shut off valves are functional
- Remove existing drive shaft pumps, drive shafts and motors
- Retain existing valves for reuse
- Provide and install (3) new Flygt dry-submersible pump set with serrated impeller blades
- Provide and install new power and control conductor wiring from VFD/line reactors to new pump housings through existing drive shaft floor openings in waterproof conduit
- Include factory start up of motors and calibration of VFDs
- Excluded backup pumping or bypass pumping

• Provide necessary engineering and project management for complete turnkey system
• Provide as built engineered drawings, test reports, cut sheets/submittal package, O&M manual
• Provide operator training

Well #6
• Coordinate working periods to minimize occupant impact
• Assume that all water shut off valves are functional
• Pull pump/motor and video inspect well casing and pump for needed rehab/develop well and/or repairs to pump/motor
• Rehab/develop well to clean screens
• Remove and replace existing 75 HP pump with new, inspect existing motors for repair
• Remove existing 6" blending intake, distribution and mixing piping
• Install new 8" intake from zone 1 system to pump house
• • Install new distribution piping to each pump and mixing water to well discharge to prevent cavitation
• Provide and install new 125 HP 460V 3Ph submersible pump with check valve
• Provide necessary engineering and project management for complete turnkey system
• Provide as built engineered drawings, test reports, cut sheets/submittal package, O&M manual
• Provide operator training

Well #8
• Coordinate working periods to minimize occupant impact
• Assume that all water shut off valves are functional
• Pull pump/motor and video inspect well casing and pump for needed rehab/develop well and/or repairs to pump/motor
• Rehab/develop well to clean screens
• Provide and install new 125 HP 460V 3Ph submersible pump with check valve
• Provide necessary engineering and project management for complete turnkey system
• Provide as-built engineered drawings, test reports, cut sheets/submittal package, O&M manual
• Provide operator training

8, Low Flow Water Efficiency Devices

The existing domestic water systems in the city buildings are generally original to the construction. These fixtures have higher water flow rates than are needed or recommended. This results in excessive water use by the buildings. This measure will replace/retro-commission existing toilets, urinal flush valves, sink aerators, showerheads and kitchen sprayer with new high efficiency equipment. City Hall, Community Center, Corporate Yard, Fire Department, Ives Pool Complex, Police Department, Sebastopol Library, Senior Center, Youth Annex, Libby Park / Garzot Building: Water systems identified in the water audit.

Water

- Per water audit
- Disconnect and reconnect water
- Coordinate working periods to minimize occupant impact
- Assume that all water shut off valves are functional
- Clean all work areas of debris and dust after domestic water work is completed
- Provide necessary engineering and project management for complete turnkey system
- Provide as built line-by-line audit, cut sheets/submittal package, O&M manual
- Provide District/operator training

9, Install New Solar PV at the Sebastopol Library

There currently is no solar photovoltaic system installed at the Sebastopol Library. This measure will install new solar PV on the roof of the library to generate electricity behind the meter. This will offset the amount of energy that the library pays to PG&E for electricity with the cost of purchased electricity from the solar PV system. By utilizing behind the meter solar PV the library will be able to more effectively manage the cost of electricity.

Solar

- Size, design and coordinate permits for proposed solar PV installation on the roof of the library
- Provide, install roof stanchions for anchoring system racking to roof
- Provide, install solar PV racking system, modules and electrical conductors
- install new electrical conduit to combine and route generated power back to building Main Electric Switchboard
- provide and install new solar electrical disconnect and circuit breaker
- coordinate installation of new PG& smart meter
- Coordinate inspections for permits and execute any items needed to complete the permit
- Provide necessary engineering and project management for complete turnkey system
- Provide cut sheets/submittal package, O&M manual, pre and post photo documentation
- Provide owner/operator training

10, Library Roof Replacement

The existing roof on the library is past the end of its useful life. The existing roof is bubbling and showing signs of wear, however, there are no leaks. There is known to be lead and/or other hazardous materials under the roof. The proposed roof will be a spray on urethane foam approximately 1" thick covered with silicone and sand for traction. This foam will be structural and will go over the existing without removal. New drip cap will be installed. There will be significant coordination with the HVAC replacement and solar PV installation scopes. This measure will provide a new leak free roof system increasing the thermal efficiency of the roof. The main benefit will be the reduced cost of installation without having to

mitigate hazardous material under the roof. Additionally, the white roof color will make cooling the building easier.

Roofing Envelope

- Remove existing drip cap and properly dispose of
- Prepare roof for new installation by cleaning and removing any bubbles
- Coordinate and install stanchions for new solar PV array anchor points
- Coordinate with HVAC mechanical work to include mechanical well in scope
- Install new foam roof 1" thick and cover with 20-year warranty coating of silicone and sand
- Provide necessary engineering and project management for complete turnkey system
- Provide cut sheets/submittal package, O&M manual
- Provide owner/operator training

11, Repair / Replace Door Sweeps and Seals

The exterior doors and exit stair well doors have missing or damaged door sweeps and seals. This allows for air, water and pest infiltration to the buildings. By repairing or replacing the door sweeps and seals of the exterior doors, the amount of infiltration will be reduced. By installing door sweeps on the interior exit doors the occupied spaces will be able to be conditioned better. Reduced infiltration and conditioned air migration will reduce the amount of energy needed to condition the occupied spaces.

Envelope

- Provide and install appropriate door sweeps and seals for all exterior exit doors
- Provide necessary engineering and project management for complete turnkey system
- Provide cut sheets/submittal package, O&M manual
- Provide owner/operator training
- Provide replacement stock for equipment as needed

12, Installation of Window Film

The windows on the East, South and Western exposures have windows that let in a significant amount of solar heat and UV radiation. There are manual shades to reduce the amount of solar glare entering the building but are typically left closed. The intent of this measure is to install window film directly on the interior surface of the glazing to reduce glare, UV and heat gain in the spaces. By reducing the amount of heat gain to the spaces the air conditioning will not have to work as hard to cool the spaces. Additionally, by reducing the amount of UV incidence in the spaces, the interior finishes will not be worn as quickly.

City Hall, Corporate Yard, Senior Center, Youth Annex: East, South and Western windows

Provide and install window film on East, South and West exposure windows
• Includes any rigging, lifts needed to provide a complete install
• Special care is to be made in selecting and installing film to not bubble and warp or damage any glazing
• Provide necessary engineering and project management for complete turnkey system
• Provide cut sheets/submittal package, O&M manual
• Provide owner/operator training

Project Cost Summary Table

ECM #	ECM Description	ECM Price ($)	% of Project Total
2.02	DESTRATIFICATION FANS	$24,708	0.5%
2.03	E-GEN HP HEATER	$32,651	0.7%
2.05	HVAC UNIT REPLACEMENT	$707,125	14.2%
2.06	POOL CHLORINE GENERATOR	$131,944	2.7%
3.01	BUILDING LIGHTING UPGRADE & STREETLIGHTS	$256,469	5.2%
4.01	CITY WATER METER REPLACEMENT	$2,213,548	44.5%
4.02	PUMP REPAIR/REPLACEMENT	$1,528,812	30.8%
4.03	DOMESTIC WATER EFFICIENCY	$37,573	0.8%
7.01	BUILDING ENVELOPE SEALING	$12,154	0.2%
7.02	WINDOW FILM	$23,907	0.5%
Total	--	**$4,968,891**	**100.0%**

	Project Price ($)	% of ECM Total	% of Project Total
Building Lighting	$238,777	93.1%	4.8%
Streetlights	$17,692	6.9%	0.4%
Total	$256,469	100.0%	5.2%

Water Production	$480,921	31.5%	9.7%
Sewer Improvements	$1,047,891	68.5%	21.1%
Total	$1,528,812	100.0%	30.8%

Badger Meter

E-Series® Ultrasonic Meter

Cold Water Engineered Polymer Meter, 5/8, 5/8 x 3/4, 3/4, and 1 inch

DESCRIPTION

The E-Series® Ultrasonic meter uses solid-state technology in a compact, totally encapsulated, weatherproof, and UV-resistant housing, suitable for residential and commercial applications. Electronic metering provides information—such as rate of flow and reverse flow indication—and data not typically available through traditional, mechanical meters and registers. Electronic metering eliminates measurement errors due to sand, suspended particles and pressure fluctuations.

The Ultrasonic 5/8, 5/8 × 3/4, 3/4, and 1 inch meters feature:

- Minimum extended low-flow rate lower than typical positive displacement meters.
- Simplified one-piece electronic meter and register that are integral to the meter body and virtually maintenance free.
- Sealed, non-removable, tamper-protected meter and register.
- Easy-to-read, 9-digit LCD display presents consumption, rate of flow, reverse-flow indication, and alarms.
- High resolution industry standard ASCII encoder protocol.

The Ultrasonic meter is available with an in-line connector for easy connection and installation to AMR/AMI endpoints. It is also available with a flying lead for field splice connection.

APPLICATIONS

Use the Ultrasonic meter for measuring potable cold water in residential, commercial and industrial services. The meter is also ideal for non-potable, irrigation water applications or less than optimum water conditions where small particles exist.

E-Series Ultrasonic meters meet and exceed ANSI/AWWA C715 standards. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 and carry the NSF-61 mark on the housing.

OPERATION & PERFORMANCE

As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter. The LCD display shows total volume and alarm conditions and can toggle to display rate of flow.

In the normal temperature range of 45…122° F (7…50° C), the Ultrasonic "new meter" consumption measurement is accurate to:

- ±1.5% over the normal flow range
- ±3.0% from the extended low flow range to the minimum flow value

CONSTRUCTION

E-Series Ultrasonic meters feature an engineered polymer, lead-free meter housing, an engineered polymer and stainless steel metering insert, a meter-control circuit board with associated wiring, LCD, and battery. Wetted elements are limited to the pressure vessel, polymer/stainless steel metering insert and the transducers. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is permanently attached to the meter housing. The transducers extend through the polymer housing and are sealed by O-rings.

The metering insert holds the stainless steel ultrasonic reflectors in the center of the flow area, enabling turbulence-free water flow through the tube and around the ultrasonic signal reflectors. The metering insert's patented design virtually eliminates chemical buildup on the reflectors, ensuring long-term metering accuracy.

METER INSTALLATION

The meter is completely submersible and can be installed using horizontal or vertical piping, with flow in the up direction. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition when the flow sensors are not fully submerged.

SPECIFICATIONS

E-Series Ultrasonic Meter Size	5/8 in. (15 mm)	5/8 x 3/4 in. (15 mm)	3/4 in. (20 mm)	1 in. (25 mm)
Normal Test Flow Limits	0.1…25 gpm (0.02…5.7 m^3/hr)	0.1…25 gpm (0.02…5.7 m^3/hr)	0.1…32 gpm (0.02…7.3 m^3/hr)	0.4…55 gpm (0.09…12.5 m^3/hr)
Minimum Test Flow Limits	0.05 gpm (0.01 m^3/hr)	0.05 gpm (0.01 m^3/hr)	0.05 gpm (0.01 m^3/hr)	0.25 gpm (0.06 m^3/hr)
Safe Maximum Operating Condition (SMOC)	25 gpm (5.7 m^3/hr)	25 gpm (5.7 m^3/hr)	32 gpm (7.3 m^3/hr)	55 gpm (12.5 m^3/hr)
Typical Pressure Loss	4.3 psi at 15 gpm (0.3 bar @ 3.4 m^3/hr)	2.3 psi at 15 gpm (0.16 bar @ 3.4 m^3/hr)	2.0 psi at 15 gpm (0.14 bar @ 3.4 m^3/hr)	1.8 psi at 25 gpm (0.12 bar @ 5.7 m^3/hr)
Reverse Flow - Maximum Rate	4.0 gpm (0.9 m^3/hr)	4.0 gpm (0.9 m^3/hr)	4.0 gpm (0.9 m^3/hr)	9.0 gpm (2.0 m^3/hr)
Operating Performance	In the normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • ± 1.5% over the normal flow range • ± 3.0% from the extended low flow range to the minimum flow value			
Storage Temperature	– 40…140° F (– 40…60° C)			
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)			
Measured-Fluid Temperature Range	34…140° F (1°…60° C)			
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments			
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)			
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high			
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters			
Register Capacity	• 10,000,000 gallons • 1,000,000 cubic feet • 100,000 cubic meters			
Totalization Display Resolution	• Gallons: 0.XX • Cubic feet: 0.XXX • Cubic meters: 0.XXXX			
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life			

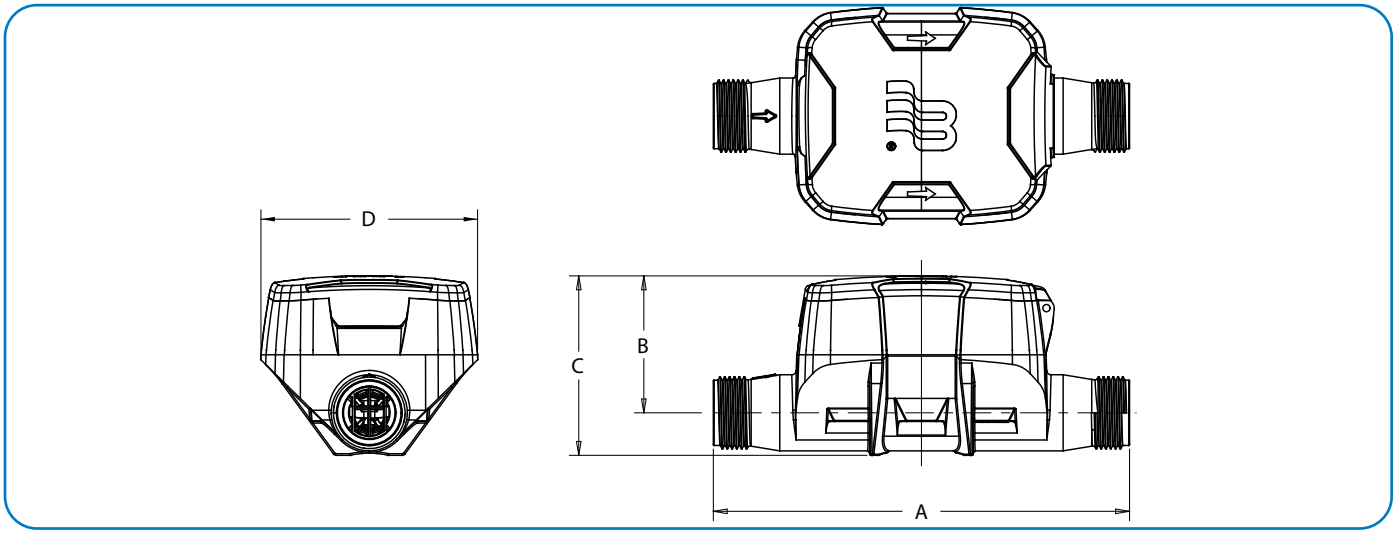
MATERIALS

Meter Housing	Engineered polymer
Measuring Element	Pair of ultrasonic sensors located in the flow tube
Register Housing & Lid	Engineered polymer
Metering Insert	Engineered polymer & stainless steel
Transducers	Piezo-ceramic device with wetted surface of stainless CrNiMo

PHYSICAL DIMENSIONS

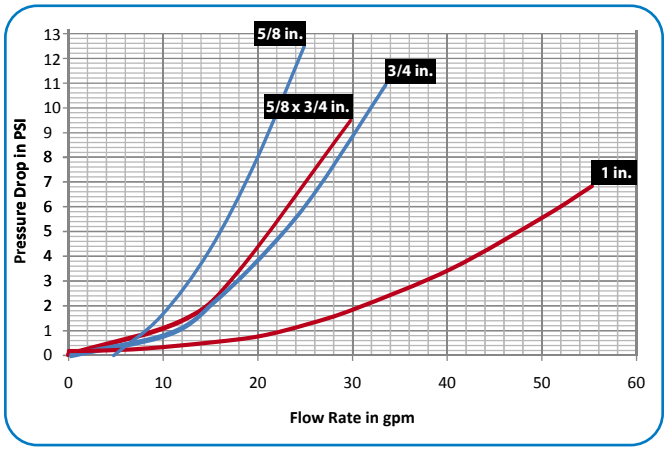
E-Series Ultrasonic Meter Size	5/8 in. (15 mm)	5/8 (15 mm) x 3/4 in. (20 mm)	3/4 in. (20 mm)	1 in. (25 mm)
Size Designation X Lay Length	5/8 × 7-1/2 in. (16 × 191 mm)	5/8 × 3/4 × 7-1/2 in. (16 × 19 × 191 mm)	3/4 × 7-1/2 in. or 3/4 × 9 in. (19 × 191 mm or 19 × 229 mm)	1 × 10-3/4 in. (25 × 273 mm)
Weight (without AMR)	1.60 lb (0.73 kg)	1.58 lb (0.72 kg)	3/4 × 7-1/2 in.: 1.58 lb or 3/4 × 9 in.: 1.64 lb (19 × 191 mm: 0.72 kg or 19 × 229 mm: 0.74 kg)	2.3 lb (1.04 kg)
See illustration below for Measurement Designations.				
Length (A)	7.5 in. (191 mm)	7.5 in. (191 mm)	7.5 in. or 8.85 in. (191 mm or 225 mm)	10.75 in. (273 mm)
Height (B)	2.46 in. (62 mm)	2.46 in. (62 mm)	2.46 in. (62 mm)	2.66 in. (68 mm)
Height (C)	3.27 in. (83 mm)	3.23 in. (82 mm)	3.23 in. (82 mm)	3.62 in. (92 mm)
Width (D)	3.90 in. (99 mm)	3.90 in. (99 mm)	3.90 in. (99 mm)	3.90 in. (99 mm)
Bore Size	5/8 in. (15 mm)	3/4 in. (19 mm)	3/4 in. (19 mm)	1 in. (25 mm)
Coupling Nut & Spud Thread	3/4 in. × 14 NPSM	1 in. × 11-1/2 NPSM	1 in. × 11-1/2 NPSM	1-1/4 in. × 11-1/2 NPSM
Tailpiece Pipe Thread (NPT)	1/2 in.	3/4 in.	3/4 in.	1 in.
Service Pipe Thread (NPT)	1/2 in.	3/4 in.	3/4 in.	1 in.

MEASUREMENT DESIGNATIONS



PRESSURE LOSS CHART

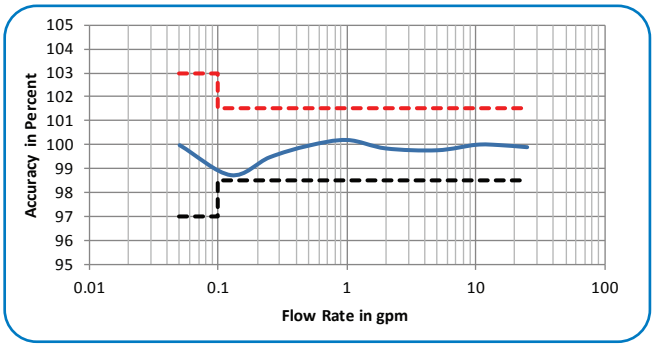
Rate of Flow in gallons per minute (gpm)



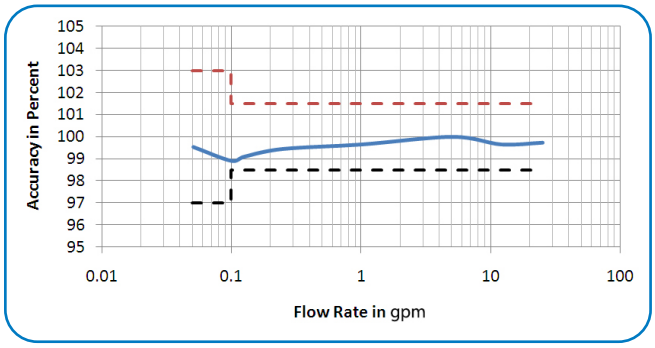
ACCURACY CHARTS

Rate of Flow in gallons per minute (gpm)

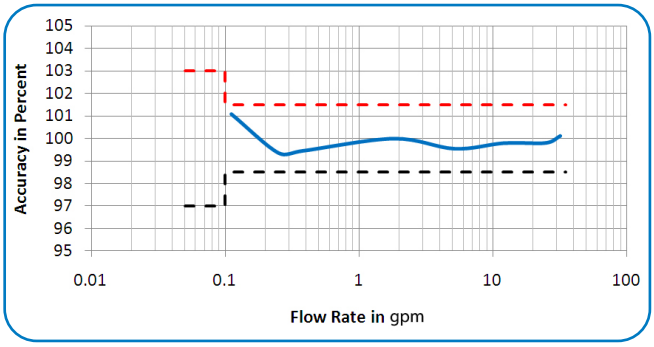
5/8 IN. METER



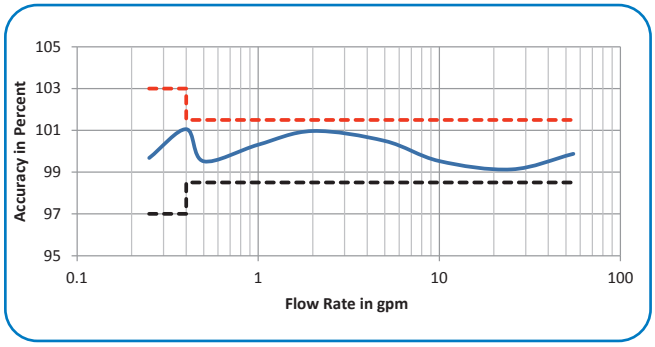
5/8 × 3/4 IN. METER



3/4 IN. METER



1 IN. METER



SMART WATER IS *BADGER METER*

www.badgermeter.com

ORION® Cellular Water Endpoints

DESCRIPTION

ORION® Cellular water endpoints are innovative, two-way endpoints for smart water applications. The endpoints utilize existing IoT (Internet of Things) cellular infrastructure to efficiently and securely deliver meter reading data to the utility in a Network as a Service (NaaS) approach. Leveraging existing cellular infrastructure, the NaaS solution offers all the performance benefits of AMI, while eliminating network-related maintenance and technology concerns and enhancing deployment flexibility.

Cellular endpoints are members of the time-tested ORION family of products from Badger Meter, designed for maximum flexibility. Since 2002, the ORION product family has provided comprehensive Advanced Metering Analytics (AMA) for interval meter reading and data capture using both one-way and two-way communications.

FUNCTIONALITY

Operation: ORION Cellular water endpoints communicate with the encoder and capture 15-minute interval read data and meter status information. The endpoints then automatically broadcast the information, including endpoint status information, via the cellular network to BEACON® AMA. ORION NaaS is powered by the proven ORION system for interval data capture and two-way communication. The solution employs cellular endpoints which, as they leverage the public cellular network and require no proprietary gateways to operate, dramatically reduce infrastructure requirements compared to a traditional fixed network. This speeds installations and simplifies expansion as a system evolves.

The endpoints are designed to call in four times each workday and feature a configurable schedule that enables utility customers to select call-in times that best support their processes.

Activation: ORION Cellular water endpoints are shipped in an inactive, non-transmitting state. The Badger Meter IR Communication Device can be used to activate the endpoints and verify the encoder connection. Successful endpoint function can be confirmed through a web app demonstrating that communication has been verified to both the encoder and the network.

Alternatively, the endpoints offer a Smart Activation feature. After installation, the endpoints begin broadcasting data when the encoder senses the first usage of water. No field programming or special tools are required.

Broadcast Mode: ORION Cellular water endpoints broadcast fixed network reading data through the secure cellular network within the service area.

Specific configurations also transmit a radio frequency (RF) message to facilitate troubleshooting in the field. See *"Configurations" on page 2.*

Data Storage: The endpoints store 42 days of 15-minute data.

ORION Cellular LTE-M endpoint (pictured)

Output Message: ORION Cellular water endpoints broadcast a unique serial number, meter reading data, and applicable status indicators. As an advanced data security measure, each message is securely transported to the BEACON AMA software only via private network and never over the public internet.

APPLICATION

Configurations: ORION Cellular water endpoints are multi-purpose endpoints that can be deployed in indoor, outdoor and pit (non-metal pit lid) applications. The electronics and battery assembly are fully encapsulated in epoxy for environmental integrity. The endpoint is available with a connector assembly for ease of installation.

Meter Compatibility: When attached to a Badger Meter High Resolution Encoder, the ORION Cellular water endpoint is compatible with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies, and with E-Series G2® Ultrasonic, E-Series® Ultrasonic, E-Series® Ultrasonic Plus, and ModMAG® electromagnetic flow meters.

Encoder Compatibility: The ORION Cellular water endpoint is suitable for use with a Badger Meter High Resolution Encoder as well as the following Badger Meter approved three-wire encoder registers that have a manufacture date within 10 years of the current date as long as the encoder has three wires connected to it and is programmed into the three-wire output mode for AMR/AMI: Honeywell® (Elster) ScanCoder® encoder with Sensus® protocol module and evoQ4 meter (encoder output); Master Meter® Octave® Ultrasonic meter encoder output; Metron-Farnier Hawkeye; Mueller Systems 420 Solid State Register (SSR) LCD; Neptune® ProRead, E-Coder®, ARB-V®, and ProCoder; and Sensus iPerl®.

Badger Meter

ORI-DS-02957-EN-07 (August 2021)

SPECIFICATIONS

Dimensions	5.125 in. (130 mm) (H) 1.75 in. (44 mm) Diameter at top 2.625 in. (W) x 2.875 in. (D) at base (67 mm (W) x 73 mm (D) at base)
Broadcast Network	Primary LTE-M cellular network, NB-IoT (Narrow Band-Internet of Things) RF message frequency is FCC-regulated 902…928 MHz frequency hopping modulation (for troubleshooting)
Operating Temperature Range • Storage, Meter Reading and RF Message (for troubleshooting) • Cellular Communications	 –40…60° C (–40…140° F) –20…60° C (–4…140° F)
Humidity	0%…100% condensing
Battery	One (1) lithium thionyl chloride D cell (nonreplaceable)

Construction: All ORION Cellular water endpoints are housed in an engineered polymer enclosure with an ORION RF board, battery and antenna. For long-term performance, the enclosure is fully potted to withstand harsh environments and to protect the electronics in flooded or submerged pit applications.

Wire Connections: ORION Cellular water endpoints are available with in-line connectors (Twist Tight® or Nicor®) for easy installation and connection to compatible encoders/meters. The endpoints are also available with flying leads for field splice connections. Other wire connection configurations may be available upon request.

Smart City Ready	Future-proof technology
Communication Type	Two-way
Application Type	Control/Monitor
Endpoint Communication	Configurable call-in schedule, up to four times each workday
Reading Interval Type	15-minute
Encoder Compatibility	Absolute
Fixed Network Reading	✓
Cut-Wire Indication	✓
Encoder Error	✓
Low Battery Indication	✓
Remote Clock Synchronization	✓
Firmware Upgrades	✓

CONFIGURATIONS

Endpoint	Notes
ORION Cellular LTE-M	Includes RF and IR messages for troubleshooting
ORION Cellular LTE-MS	Secondary carrier; includes RF and IR messages for troubleshooting
ORION Cellular C	Includes RF and IR messages for troubleshooting
ORION Cellular HLA	Includes IR message for troubleshooting

NOTE: For the ORION Cellular LTE-MP endpoint, see the *ORION Cellular LTE-MP Endpoint product data sheet*, available at *www.badgermeter.com*.

FEATURES

License Requirements: ORION Cellular water endpoints comply with Part 15, Part 22, Part 24, and Part 27 of the FCC Rules. No license is required by the utility to operate an ORION meter reading system. This device complies with Industry Canada license-exempt RSS standard(s).

Transportation: **WARNING**: The operation of transmitters and receivers on airlines is strictly prohibited by the Federal Aviation Administration. As such, the shipping of radios and endpoints via air is prohibited. Please follow all Badger Meter return and/or shipping procedures to prevent exposure to liability.

Warning: To reduce the possibility of electrical fire and shock hazards, never connect the cable from the endpoint to any electrical supply source. The endpoint cable provides SELV low voltage limited energy power to the load and should only be connected to passive elements of a water meter register.

Caution: Endpoint batteries are *not* replaceable. Users should make no attempt to replace the batteries.
Changes or modifications to the equipment that are not expressly approved by Badger Meter could void the user's authority to operate the equipment.

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Encoders
High Resolution Encoders

HR-E® LCD Encoder

DESCRIPTION

Applications: The High Resolution encoder (HR-E LCD) is a fully electronic, solid-state encoder with no moving parts. It is designed for use with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies. The HR-E LCD provides connectivity with Badger Meter ORION® and GALAXY® AMR/AMI endpoints and other AMR/AMI technology solutions approved by Badger Meter.

NOTE: For more detailed information, refer to the document *HR-E LCD Encoder User Manual*, available at *www.badgermeter.com*.

Field Programmable: The HR-E LCD encoder comes standard as factory programmed to customer specifications, with the option for field programming the unit of measure, meter type, meter model, digit resolution from the encoder, billing units, and rate-of-flow time and units. Programming is performed through the IR port via a computer.

Electronic Resolution: Standard encoded output from the HR-E LCD is nine digits.

Status Indicators: Status indicators are sent as part of the encoder extended message to AMR/AMI systems such as ORION Cellular, Fixed Network and Migratable endpoints that are capable of receiving an extended message. The details can also be read through an IR interface.

Mounting: Icons on the HR-E LCD encoder face indicate encoder status and alarm conditions. The fully potted encoder assembly has a bayonet mount compatible with all Recordall Disc, Turbo Series, Compound Series, Combo Series and Fire Series meters and assemblies. The bayonet mount positions the encoder in any of four orientations for visual reading convenience. The HR-E LCD encoder can be removed from the meter without disrupting water service.

Magnetic Drive Communication: The HR-E LCD encoder detects movement of the wet side meter magnet with magnetic sensors to provide reliable and dependable encoded communication.

Tamper-resistant Features:
Unauthorized removal of the HR-E LCD encoder is inhibited by a tamper-resistant Torx® seal screw. Torx seal screws are provided as standard accessories. Optional proprietary tamper-proof screws are also available.

Magnetic sensors detect and report an attempted encoder removal. In addition, the HR-E LCD encoder is resistant to magnetic tampering. The encoder detects an attempted tamper—as well as encoder removal—and sends a tamper alarm in either situation. Approved endpoints capable of receiving the alarms, such as ORION Cellular, Fixed Network and Migratable endpoints, can then report the tamper condition to the meter reading software.

SPECIFICATIONS

Encoder type	Straight reading, permanently sealed, electronic LCD absolute encoder with field-programmable option
Encoder display	Status indicators, unit of measure, billing units, automatic toggle between 9-digit and 6-digit consumption (segmented leak detector in this mode), rate of flow, meter model
Unit of measure	U.S. gallons, Imperial gallons, cubic feet, cubic meters, and liters clearly identified on register face
Flow rate	Seconds, minutes, and hours
Numerals	7 mm (0.28 in.) high
Weight	11 ounces
Humidity	0…100% condensing
Temperature	Storage: – 40…60° C (– 40…140° F) Max. ambient for 1 hr: 70° C (158° F) Electronics & Display: –10…60° C (14…140° F)
Status indicators	Electronic and visual icons for: meter functioning correctly, meter alarm (indicates temperature limits exceeded, magnetic tamper or encoder removal), reverse flow, suspected leak, 30-day no usage, end of battery life
Signal output	Industry standard ASCII format
Signal type	Three-wire synchronous for AMR/AMI solutions Red = clock/power; Black = ground; Green = data
Battery	Lithium thionyl chloride AA cell, fully encapsulated within encoder housing
Battery Life	20 years (calculated)

Badger Meter

Construction: The housing of the HR-E LCD encoder is constructed of an engineered polymer enclosure and a polycarbonate lens. For long-term performance, the enclosure is fully encapsulated, weatherproof, and UV-resistant to withstand harsh environments and to protect the electronics in flooded or submerged pit applications. An epoxy potting (patented design - 8,482,908) comprises the encoder bottom. Due to this unique sealing, the HR-E LCD exceeds all applicable requirements of AWWA Standard C706 and C707.

Wire Connections: The HR-E LCD encoder is available with an in-line connector for easy connection and installation to AMR/AMI endpoints. It is also available with a flying lead for a field splice connection, or fully prewired to an AMR/AMI endpoint.

Operating Characteristics: The HR-E LCD encoder is shipped in storage mode so a meter status alarm is not triggered. In storage mode, the meter model screen is displayed. Upon sensing two revolutions of the meter magnet, the encoder goes into normal operation mode. The display then automatically toggles between these four modes:

- 9-digit consumption displays for 45 seconds.
- 6-digit consumption (segmented leak detector in this mode) displays for 5 seconds.
- Rate of flow displays for 5 seconds.
- Meter model displays for 5 seconds.

DIMENSIONAL DRAWINGS

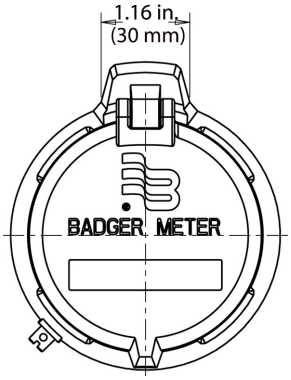

Figure 1: Top view

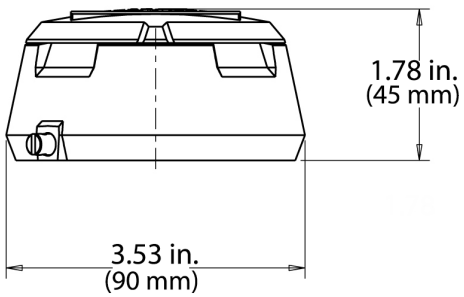

Figure 2: Front view

MEASUREMENT RESOLUTION

The electronic encoder output resolution of the HR-E LCD is as noted below.

Recordall Disc Series	Size (in.)	9-dial encoder output (gal)	9-dial encoder output (ft^3)	9-dial encoder output (m^3)
LP	5/8, 5/8 x 3/4	0.01	0.001	0.0001
M25	5/8 , 5/8 x 3/4	0.01	0.001	0.0001
M35	3/4	0.01	0.001	0.0001
M40	1	0.01	0.001	0.0001
M55	1	0.01	0.001	0.0001
M70	1	0.01	0.001	0.0001
M120	1-1/2	0.1	0.01	0.001
M170	2	0.1	0.01	0.001

Recordall Turbo Series	Size (in.)	9-dial encoder output (gal)	9-dial encoder output (ft^3)	9-dial encoder output (m^3)
T160	1-1/2	0.1	0.01	0.001
T200	2	0.1	0.01	0.001
T450	3	0.1	0.01	0.001
T1000	4	0.1	0.01	0.001
T2000	6	1	0.1	0.01
T3500	8	1	0.1	0.01
T5500	10	1	0.1	0.01
T6200	12	10	1	0.01
T6600	16	10	1	0.01
T10000	20	10	1	0.01

Recordall Compound Series	Size (in.)	9-dial encoder output (gal)	9-dial encoder output (ft^3)	9-dial encoder output (m^3)
High Side T200	2	0.1	0.01	0.001
Low Side M25	2	0.01	0.001	0.0001
High Side T450	3	0.1	0.01	0.001
Low Side M25	3	0.01	0.001	0.0001
High Side T1000	4	0.1	0.01	0.001
Low side M35	4	0.01	0.001	0.0001
High Side T2000	6	1	0.1	0.01
Low Side M35	6	0.01	0.001	0.0001
High Side T3500	8	1	0.1	0.01
Low side M120	8	0.1	0.01	0.001

NOTE: For Fire Service Meters and Assemblies, please refer to appropriate Disc and TSM information provided above.

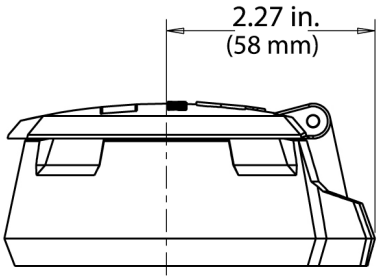

Figure 3: Left side view

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ORION®
Cellular/Fixed Network Solutions

ORION® Cellular Endpoints

This document provides information regarding radio frequency (RF) of the ORION® Cellular endpoint.

Badger Meter is the market leader for utility cellular solutions, having deployed millions of endpoints with thousands of customers.

Cellular technology for machine-to-machine applications is designed to ensure transmission accuracy, immunity from outside interference and other forms of attenuation to avoid the loss of customer data. Likewise, the ORION Cellular endpoint is designed to eliminate interference from outside electromagnetic and RF energy fields. As its primary communication, the ORION Cellular endpoint utilizes licensed frequencies that are specifically set aside for its cellular communications, recognized as one of the most secure approaches to network communication available. Specific configurations also transmit an RF message to facilitate troubleshooting in the field.

FAQS

What standards related to RF emissions apply to ORION Cellular endpoints?

In the United States, FCC and CTIA are the bodies responsible for regulating domestic wireless telecommunications programs and policies, including licensing, and are responsible for implementing rules and regulations regarding frequency allocations, operating and design characteristics of equipment, power limits and testing/certification requirements, among other responsibilities. As its primary communication, the ORION Cellular endpoint utilizes licensed frequencies that are specifically set aside for its cellular communications. ORION Cellular endpoints utilize licensed frequencies to avoid interference from unauthorized users. Certain configurations of the ORION Cellular endpoint include an additional RF message for troubleshooting that communicates on the FCC-regulated 902-928 MHz frequency. ORION Cellular endpoints comply with Part 15, Part 22, Part 24 and Part 27 of FCC Rules.

Are there any health impacts related to these RF emissions?

The radio frequency signals broadcast from the ORION Cellular endpoint are well below the levels most people come into contact with on a typical day in their home. Devices such as televisions, wireless phones and cell phones all utilize radio frequency technology that provides much greater contact to radio frequency signals. The endpoint operates like a cell phone and under normal operation will awaken approximately four times per day to communicate data via the cellular network. Some configurations include an additional RF message for troubleshooting. The duration of each of these RF transmissions is 1.4 milliseconds, equating to approximately 8 seconds of transmission time per day. This means that the endpoint transmits as little energy as a brief cell phone call.

Additionally, the exposure to radio frequency signals decreases with the square of the distance to the device. This means the farther away anyone is from the RF device, the less the radio frequency contact. For example, the energy measured two feet away from the endpoint is 1/4 of the energy measured at a distance of one foot. Since the ORION endpoint is typically located in the basement, on the outside of the house or in a pit below grade away from the house, the extended distance and material between the endpoint and the individual further reduces contact with radio frequency signals.

What is the output power of the ORION Cellular endpoint during a data transmission?

The ORION Cellular endpoint is designed for reliable data delivery over long distances, transmitting at a maximum power that is governed by the cellular standard, 23 dBm (0.20 W). For configurations that support the RF message for troubleshooting, the RF broadcast will be at approximately 10 dBm.

continued on back page

What frequencies do ORION Cellular endpoints utilize?

As its primary communication, the ORION Cellular endpoint utilizes licensed frequencies that are specifically set aside for cellular communications. Unlike many AMI solutions that use shared frequencies and bandwidth, ORION Cellular endpoints utilize licensed frequencies to avoid interference from unauthorized users. Endpoint configurations that support the RF message for troubleshooting communicate on the FCC-regulated 902-928 MHz frequency. ORION Cellular endpoints comply with Part 15, Part 22, Part 24 and Part 27 of FCC Rules.

ORION CELLULAR ENDPOINT CONFIGURATIONS

Endpoint	Troubleshooting Message
ORION Cellular LTE-M	Includes RF and IR messages for troubleshooting
ORION Cellular LTE-MS	Includes RF and IR messages for troubleshooting
ORION Cellular C	Includes RF and IR messages for troubleshooting
ORION Cellular HLA	Includes IR message for troubleshooting

TERMS

dBm decibel-milliwatts
IR infrared
RF radio frequency
W watts

Purchase Order

PO # 22291-4009E20 **Job 4009EP20MU City of Sebastopol Energy Solutions PH1** Page: 1

Vendor: 2731
Badger Meter, Inc.
4545 W Brown Deer RD, PO Box 245036
Milwaukee, WI 53224-9536 US

Date Ordered: 12/16/21
Ordered By: AC
Expected Date : 12/16/21
Payment Terms: Net 30 days

Bill :
Syserco Energy Solutions, Inc.
AREnergy@syserco.com
215 Fourier Ave. Suite 140
Fremont, CA 94539

1	OTHER	BMI Part No.: 103-4363 **CAT String:** EP-EAC-PXTX-E5-CA-19FD-A2Y2-XXT2-XX-BOA **Description:** E-Series EP, 5/8" x 3/4" (7-1/2), Thk Wshr, ENC, 4CXN2 ORION, 9D-0.001 FT3, SN Yr 9d & PBB, TT CblShld-5', BMI STD. **Unit of Measure:** U.S. Gallons	EA	625.000	123.50000E	[redacted]
2	OTHER	BMI Part No.: 104-5512 **CAT String:** CAT String: R4-BA1-E1CA-2B1-9FD-NN-XX-T2-XX-BOA **Description:** REG 4,M25, HR-E-LCD, 4CXN2 ORION,PL Lid/Shrd-GRY, Trx Scrw, 9D-0.001 FT3, SN YR 9D in & out, TT CblShld-5', BMI STD. **Unit of Measure:** U.S. Gallons	EA	646.000	65.00000E	[redacted]
3	OTHER	BMI Part No.: 100-6580 **CAT String:** CAT String: E4-4E-AB-AG-T1AA-BOA **Description:** EP Only, For Enc. ORION LTE-M, Thru Ld Instl Kit, TT Cbl/Shld-8in, Grnd/ Ocean-Pause, BMI STD **Unit of Measure:** U.S. Gallons	EA	3,002.000	112.00000E	[redacted]

Subtotal [redacted]
Total [redacted]

Syserco Energy Solutions, Inc. AREnergy@syserco.com, Fremont, CA 94539

Phone: 510.498.1410 Fax:

Purchase Order

PO #22259-4009E20 **Job 4009EP20MU City of Sebastopol Energy Solutions PH1** Page: 1

Vendor: Badger Meter
2731 4545 W Brown Deer RD, PO Box 245036

Milwaukee, WI 53224-9536 US

Date Ordered: 01/27/21
Ordered By: AC

Expected Date : 01/27/21
Payment Terms:

Bill : **Syserco Energy Solutions, Inc.**
215 Fourier Ave.
Fremont, CA 94539

Ship To: City of Sebastopol
Corporate Yard - 714 Johnson St
Sebastopol, CA 95472

1	OTHER	5/8"x3/4" E-Series Ultrasonic meter, Engineered Polymer housing, w/HR-E LCE 9-dial encoder register, CF, 5' Twist Tight with Armor Cable	EA	46.000	131.50000E	[redacted]
2	OTHER	1" E-Series Ultrasonic meter, Engineered Polymer housing, w/HR-E LCE 9-dial encoder register, CF, 5' Twist Tight with Armor Cable	EA	10.000	178.75000E	[redacted]

Subtotal [redacted]

Total [redacted]

Syserco Energy Solutions, Inc. 215 Fourier Ave., Fremont, CA 94539

Phone: 510.498.1711 Fax: