Rebuttals to William Bathgate Testimony
March 9, 2018

The purpose of this document is to outline inaccuracies in the "Evaluation of the Itron OpenWay AMI Meter" by William Bathgate dated December 2, 2016 for OpenWay meters.

Slide 6 – The HW 3.1 OpenWay CENTRON and OpenWay Riva CENTRON meters are UL 2735 approved devices. He also states 5 – 7 year life which is easy to disprove. Itron meters are designed to have a life expectancy of 20 years and a long, maintenance-free operating life. We prove this out with Accelerated Life Testing (ALT). Meters are submitted for testing as follows:

- Preliminary ALT, early hardware and early firmware or test code
- Final Round 1 ALT, final or near-final hardware and application code
- Final Round 2 ALT, final hardware and firmware, incorporating any changes

Stress conditions employed as follows:

- High Temperature High Humidity (HTHH), 80°C / 80% R.H.
- Temperature Cycling (TC), -40/+85°C, ~5 cycles per day
- High Temperature (HT), 90°C Constant

Samples sizes and durations as follows:

Round	Stress	Sample Size	Duration
Preliminary	HTHH	30 meters	1250 hours
Final Round 1	HTHH	50 meters	1250 hours
	TC	50 meters	1500 hours
	HT	50 meters	5000 hours
Final Round 2	HTHH	50 meters	1250 hours
	TC	50 meters	1500 hours
	HT	50 meters	5000 hours

Meters are powered at 240VAC throughout the ALT, with an applied load of ~10A.

Read points are conducted to monitor functionality: Accuracy, Visual / Display, Switch, WiFi, RF LAN, PLC, Energy Accumulation. Default test intervals will be 250 hours for HTHH and TC, 1000 hours for HT.

The basic calculation of failure rate is: # of failures / (acceleration factor * sample size * duration). The Chi-square one-sided upper limit, with 60% confidence, is applied.

Models and acceleration factors (AF) for each stress profile are as follows:

Stress	Model	AF
HTHH	Eyring	149
TC	Coffin-Manson	119
HT	Arrhenius	36

We also pull samples daily from the production line and perform ALT on them:

- Sample meters are pulled daily from production and run through Temperature Cycling (-40°C/+85°C) and High Temperature High Humidity (80°C/80% R.H.) tests.

Slide 7 – FCC and ANSI regulate the emission due to SMPS and Itron complies with these standards. Also, UL 2735 approval of the design has been achieved.

Slide 10 – 900 MHz causing issues - We comply with all FCC certification related to intentional transmitters.

Slide 12 – Again we are FCC Part 15 compliant. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

Slide 20 – The device he labeled as Thermistor (which is used for temperature measurement) is actually a Varistor (used for surge protection). The device has been tested by UL, Metlabs, MC, several utility customers, and internal certification to meet all standards regulating the meters. This includes 6KV, 3000 Amp voltage transients.

Slide 26 – The Itron switch use 4 contacts to carry the current. The switch can carry 200 amps continuously with no impact on performance and has been tested by UL, Metlabs, MC, several utility customers, and internal certification to meet all standards regulating the meters.

Slide 28 – While the meter does have two separate transceivers one at 900 MHz and 2.4 GHz they are mislabeled in the drawing. The 2.4 GHz is on the Meter system board

Slide 29 – The Antenna is not shared between the two transceivers. The Antenna for the 2.4 GHz is on the meter system board.

Slides 31 – 33 – Itron uses radio strategy's which is approved under FCC rules. Also, 900 MHz data can also be encrypted.

Slide 35 –Mr. Bathgate is referring to load profile which has been around for years. Utilities want to plan their production. The question they want answered is: when do we have to provide high power? When do we have to provide low power? If utilities can answer these questions, then they can know what generators to turn on and when. Indeed, generators are spread over the country and the needs for power is different in Alaska compared to Georgia. Planning for the utility is a major task. Good planning increases the quality of the service (reducing the number of outages) and decreases the production cost.

One way to achieve this is to monitor the energy consumption over time. The bill however is based on the consumption over the month.

Mr. Bathgate is dreaming on bullets 2 and 3.

The LED he refers to in bullet 4 is the test LED. If it were a grow house, don't you think the increased usage that would be way over, and above normal household usage would show up as an indicator on the a monthly bill? How utilities alert Police of possible grows houses would be handled from high usage not a bill.

A thieve is not going to look at an LED on a meter to determine if some is at home. They will use other means. time

Slides 37 - Solid state meters are more accurate than previous generation meters. The meters are approved to meter with accuracy class 0.5% limits instead of the traditional class 2%. The ANSI standard also requires accuracy to be validated from -20C to 55C not only at room temperature as the author suggests.

Slide 38 – The Itron Meter measures the voltage and current over 4000 times per second and totalizes these values. It does not use an averaging of the peak method described in the document.

Slide 39 – The energy used to run the meter is not metered. The power supply connection is connected to the line side of the meter (top blades) and the current measurements are taken on only the current which flows through the load side connections. Also, ANSI requires the meter to pass a NO load test which validates the meter does not accumulate when only voltage is applied. The device has been tested by Metlabs, Measurement Canada, several utility customers, and internal certification to meet all standards regulating the meters.

Also, the power needed to run the meter is less 5 watts. This means that during the day a meter would use less than .120 kWh per day. This reading has been validated by Metlabs, MC, Several utility customers, and internal.

Slide 40 – Again, the end customer is not billed for the energy to run the meter. The analysis also completely flawed due to the error in the 2.1 kWh vs 0.120 kWh per day.

Slide 41 – ALT test data listed in the Slide 6 rebuttal along with the following data refute his claim:

Itron has a proven track record for highly reliable products. Itron meters were designed to have a life expectancy of 20 years and a long, maintenance-free operating life.

Itron utilizes the Yearly Return Rate (YRR) model as we believe it is a more accurate depiction of field reliability compared to MTBF.

Annualized failure rates* based on actual product returns are as follows:

» Electric Meter/Module – less than 0.5% (singlephase) and 0.75% (polyphase)

*Failure rate is based on historical data and accelerated life cycle testing. The rate is based on normal use and does not include failures due to abuse or improper installation.

Using these annualized failure rates, the following MTBF rates would apply:

» Electric Meter/Module – 200 years

Itron's low yearly failure rates on CENTRON products are attributed to the Continuous Improvement program instituted at the West Union, South Carolina manufacturing facility. The four areas of focus of this program are the following:

» Analysis of Customer Returns
  - 100% troubleshooting down to the component level is done in Customer Returns.
  - Additional analysis may be performed in Engineering to determine root cause.
  - Pareto of failures is used to identify the top issues by failure rate, trend, and severity, and to drive determination of root cause and corrective action.

» Monitoring with Accelerated Life Testing (ALT)
  - Sample meters are pulled daily from production and run through Temperature Cycling (-40°C/+85°C) and High Temperature High Humidity (80°C/80% R.H.) tests.

» Component Failure Analysis
  - Once internal troubleshooting has identified a potentially defective component, it may be sent to the manufacturer for failure analysis and response.
  - These can come from: Accelerated Life Testing, Customer Returns, Manufacturing.

» PDCA (Plan, Do, Check, Act)
  - Recurring issues drive corrective action, via the formal PDCA process. These can be either internal or external.
  - Regular tracking of customer returns to ensure the effectiveness of corrective actions.

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Slide 42 – Bullet 1 – UL has tested and approved the switch. We specify the product to 5000 cycles at max load and 30000 mechanical cycles (internally tested to 6000 and 50000 respectively)

Bullet 2 – The FCC, UL, and Metlabs have tested and confirmed the Itron design passes all conducted and radiated emission standards.

Bullet 3 – The power to run the meter is not measured or charged to the customer.

Slide 43 – Bullet 1 – Below is some security information to refute his claim:

With Itron's Enhanced Security architecture, cryptographic processing at the OpenWay Meter is done using algorithms recommended by the National Security Agency under their "Suite B" recommendations for commercial security. Elliptic Curve Cryptography (ECC) provides the most security per bit of any known public-key scheme. Leveraging enhanced security provides not just confidentiality for the information flow between the HES and the smart meter but also message integrity. This makes it considerably more difficult for an attacker to inject falsified messages into the system either from the HES to the smart meter or from the meter to the HES. Each CENTRON meter has a unique private key, which is used to validate digitally signed commands received from the HES and to authenticate the meter to the HES during initial meter registration.

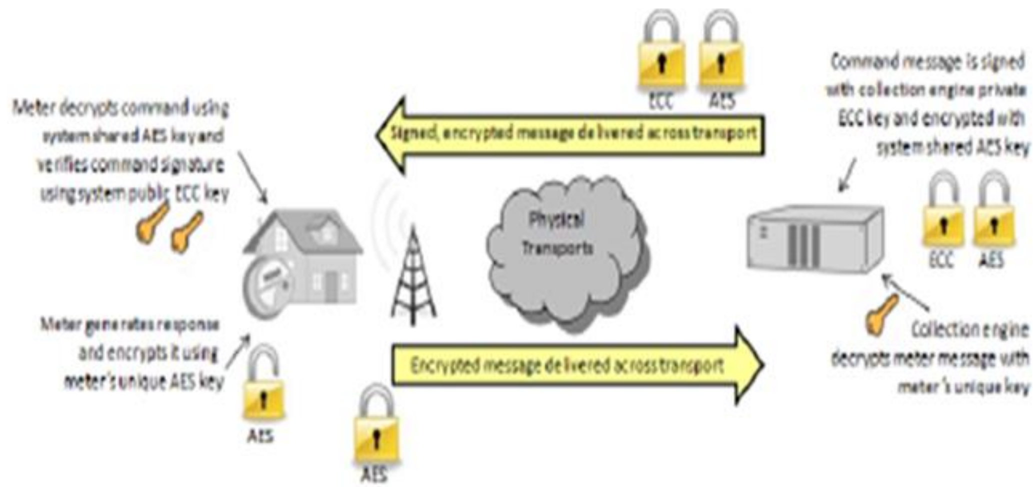

Figure 7 – Enhanced Security

<u>Messages from the HES to the Smart Meter</u>

Messages from the HES to the meter are encrypted using an AES-128 bit key and signed using an ECC-283 bit key as shown in Figure 7 – Enhanced Security. The security architecture allows for broadcast and multicast communications, where a single message from the HES can direct behavior for a large number, potentially millions, of meters simultaneously as well as for unicast communications. Signature verification and decryption is pushed out to the meters in a distributed fashion. The meter processes these security functions in milliseconds once the command is received. Thus, while each meter will need to validate the signature on the message to ensure its authenticity, those validations occur in parallel resulting in very little latency being added to a group operation no matter how many meters are involved. The HES can easily sign and encrypt 200 operations per second.

<u>Messages from the Smart Meter to the HES</u>

Messages from the meter to the HES are encrypted using an AES-128 bit key to provide customer data confidentiality as shown in Figure 7 – Enhanced Security. Itron's architecture is optimized such that an IP load balancer shapes the incoming traffic and distributing it equally among the HES subcomponents for processing. The HES removes the network portion of the packet and passes the payload to Itron's Decryption and Key Update Server for processing. This appliance is scaled to decrypt 20,000 messages per second, which maps out to over a million meters per minute processing.

Local Access to the Meter

All OpenWay CENTRON meters are configurable to use either C12.18 or Signed Authorization (OpenWay Riva CENTRON support Signed Authorization only) for local meter communications via the optical port or ZigBee (OpenWay CENTRON), or Wi-Fi (OpenWay Riva CENTRON) depending on utility preference. Signed authorization requires that the field technician have signed credentials to gain access to the meter optically or through ZigBee. This configurable setting is part of the meter's configuration as defined in the Collection Engine.

If standard C12.18 security is selected, the OpenWay CENTRON meter will allow access via the optical port using the meter passwords. The OpenWay CENTRON meter supports up to four levels of meter passwords:

- Level 4 – Full Access
- Level 3 – Limited Access
- Level 2 – Read Only + Access
- Level 1 – Read Only Access

Signed authorization requires that a field technician have signed credentials to gain access to the meter optically or through ZigBee or Wi-Fi. Local access to the meter is governed by the type meter installed. These credentials are time stamped and contain a list of meters the technician can access. OpenWay Field-Pro (used to connect locally to OpenWay CENTRON meters) and FDM Tools (used to connect locally with OpenWay Riva CENTRON meters) requests these credentials each day from the HES. Two methods are used to obtain credentials:

- **Certificate Exchange** requires that each computer capable of requesting credentials be loaded with a certificate that is used to verify a trusted relationship between that computer and the Collection Engine. This certificate can be provided by the utility's IT department or a third party.
- **Active Directory Validation** requires the use of an Active Directory with users uniquely defined in the Collection Engine role-based security.

The credentials that are passed back indicate the user, the level of access they are being provided, and the time period for which the credential is valid. OpenWay Tools and FDEM Tools always asks for the maximum duration setup in the HES. This value defaults to 24 hours but can be changed in the HES user interface.

Physical Security of the Smart Meter

To combat physical tampering of the meter, the OpenWay meters provide tamper detection and reporting through the network. OpenWay meters detect Inversion, Removal, Outage, Magnetic Tamper Detect, Magnetic Tamper Cleared, Reverse Power Flow and Unauthorized network access attempt and stores this information in the meter's event log. Additionally, OpenWay meters can be configured to send tamper alarms to the HES immediately. These alarms, in turn, can be provided in near real time to upstream systems using the HES's publish/subscribe interface.

Bullet 2 – We have numerous reports on RF exposure available. They have been submitted with this document.

Bullet 3 – The OpenWay CENTRON meters are compliant to the following standards:

- ANSI C12.1 – 2008 (American National Standard for Electricity Meters – Code for Electricity Metering)
- ANSI C12.18 – 2006 (American National Standard – Protocol Specification for ANSI Type 2 Optical Port)
- ANSI C12.19 – 2008 (American National Standard – Utility Industry End Device Data Tables)
- ANSI C12.20 – 2010 (American National Standard for Electricity Meters – 0.2 and 0.5 Accuracy Classes)
- ANSI C12.22 – 2008 (American National Standard – Protocol Specifications for Interfaces to Data Communication Networks)
- ANSI/IEEE C62.45 – 2002 (Guide to Surge Testing on Low-Voltage AC Power Circuits)
- ANSI MH 10.8 – 2005 Specification for Bar Code
- ANSI ASQZ 1.4 – 2008 Sampling Procedures and Tables for Inspection by Attributes
- IEC 61000-4-2 2008
- IEC 61000-4-4 2012
- IEEE C37.90.1 – 2004 SWC Surge Testing
- IEEE C62.41.2 Recommended Practice on Surge Testing for Equipment Connected to Low Voltage (1000V or less) AC Power Circuits C62.45 2002
- NEMA SG-AMI 1 – 2009 Requirements for AMI Meter Upgradeability
- IEC 62052-11 (2003-02) Part 11 Metering Equipment, General Requirements, Test and Conditions)
- FCC Part 15
- UL 2735

OpenWay Riva CENTRON meters are compliant to the following standards:

- ANSI C12.1 (American National Standard for Electricity Meters – Code for Electricity Metering)
- ANSI C12.10 (American National Standard for Electricity Meters – Physical Aspects of Watt-hour Meters)
- IEC 62056 – DLMS/COSEM suite of standards
- ANSI C12.20 (American National Standard for Electricity Meters – 0.2 and 0.5 Accuracy Classes)
- ANSI/IEEE C62.45 (Guide to Surge Testing on Low-Voltage AC Power Circuits)
- ANSI MH 10.8 Specification for Bar Code
- ANSI ASQZ 1.4 Sampling Procedures and Tables for Inspection by Attributes
- IEC 61000-4-2
- IEC 61000-4-4
- IEEE C37.90.1 SWC Surge Testing

- IEEE C62.41.2 *IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits*
- NEMA SG-AMI 1 Requirements for AMI Meter Upgradeability
- IEC 62052-11 (Part 11 Metering Equipment, General Requirements, Test and Conditions)
- FCC Part 15, Class B
- UL 2735
- NISTIR 7628 Guidelines for Smart Grid Security