From: Mary Hirzel [mailto:mhirzel@gmail.com]
Sent: Thursday, March 29, 2012 1:56 PM
To: solom@dteenergy.com
Cc: Kunkle, Mary Jo (LARA); MPSC_Commissioners
Subject: Your March 16, 2012 submission to MPSC

Dear Mr. Solo,

I read, with pleasure, your March 16, 2012 submission (attached) to the MPSC, in which you state that "Edison is developing an opt-out program." (p.7)

Today I received a certified letter from DTE that informs me "The advanced metering equipment referenced in your letter is not optional....Therefore, we plan to proceed with the advanced meter installation as scheduled."

When I phoned the MPSC this morning to try to reconcile these two diametrically opposed announcements, I was told the MPSC is totally ignorant of any knowledge of your announcement.

I am writing to you as I need to know, definitively, whether or not an opt-out program is, in fact, being offered. I am the mother of two disabled children and have too many demands on my time to keep chasing facts about this issue. If I need to be hiring an attorney, I'd rather know it right now.

Thank you for your time and help with clarification.

Sincerely,
Mary Hirzel
Ann Arbor, MI

The Detroit Edison Company
One Energy Plaza, Detroit, MI 48226-1279

Detroit Edison
A DTE Energy Company

Michael J. Solo, Jr.
(313) 235-9512
solom@dteenergy.com

March 16, 2012

Ms. Mary Jo Kunkle
Executive Secretary
Michigan Public Service Commission
6545 Mercantile Way
Lansing, Michigan 48909

Re: In the matter, on the Commission's own motion, to review issues bearing on the deployment of smart meters by regulated electric utilities in Michigan
Case: U-17000

Dear Ms. Kunkle:

Attached for electronic filing in the above-captioned matter is The Detroit Edison Company's Response to the Michigan Public Service Commission Information Request regarding Smart Meters.

Very truly yours,

Michael J. Solo, Jr.

MJS/lah
Attachment

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

*****

In the matter, on the Commission's own motion, to review issues bearing on the deployment of smart meters by regulated electric utilities in Michigan	))))	Case No. U-17000

The Detroit Edison Company's Response to the Michigan Public Service Commission Information Request regarding Smart Meters

The Michigan Public Service Commission ("Commission" or "MPSC") issued its order in the above referenced docket directing all regulated electric utilities to submit information regarding the following topics: (1) The electric utility's existing plans for the deployment of smart meters in its service territory; (2) The estimated cost of deploying smart meters throughout its service territory and any sources of funding; (3) An estimate of the savings to be achieved by the deployment of smart meters; (4) An explanation of any other non-monetary benefits that might be realized from the deployment of smart meters; (5) Any scientific information known to the electric utility that bears on the safety of the smart meters to be deployed by that utility; (6) An explanation of the type of information that will be gathered by the electric utility through the use of smart meters; (7) An explanation of the steps that the electric utility intends to take to safeguard the privacy of the customer information so gathered; (8) Whether the electric utility intends to allow customers to opt out of having a smart meter; and (9) How the electric utility intends to recover the cost of an opt out program if one will exist.

The Detroit Edison Company ("Company" or "Edison") hereby submits its responses pursuant to the Commission's Order. The use and deployment of smart meters in Edison's service territory is safe and provides important benefits to the reliability and operation of the electric system that serves our customers. It also provides an ability to enhance service to our customers. The data gathered by Edison is gathered in a secure and encrypted manner, is held confidential, not shared or distributed to third parties and used only for legitimate utility business. Edison applauds the Commission for addressing these issues regarding smart meters and for creating a forum for getting accurate and reliable information to the public and Edison's customers on this subject. Much of the information that is circulating in media and on the internet is inaccurate, misleading and in some cases deliberately alarmist. Edison is confident that the Commission's review will provide clarification on many of the issues and will provide useful information to utility customers and the municipalities within Edison's service territory.

TOPICS

(1) The electric utility's existing plans for the deployment of smart meters in its service territory

There are nearly 4.0 million meters and modules in the DTE Energy Advanced Metering Infrastructure ("AMI") project. Edison intends to install nearly 2.6 million electric meters and Michigan Consolidated Gas Company ("MichCon") will be installing 1.3 million gas modules in the project plan.

Installation of AMI smart meters and gas modules began in 2008. Edison conducted an initial pilot phase installing approximately 6,000 electric meters and 4,000 gas modules. This pilot phase concluded in 2009.

In the summer of 2009, the Company started the second phase of pilot installation spanning three areas: Harsens Island, Milford and West Bloomfield. After those three areas were completed, the Company continued installations throughout the rest of Oakland County in 2010 and 2011, installing nearly 650,000 AMI smart meters and gas modules.

Beginning in 2012, plans include installing an additional 457,000 AMI smart meters and gas modules, bringing the total installations to over 1.0 million by year end 2013 with the remainder of the installations occurring in future years.

(2) The estimated cost of deploying smart meters throughout its service territory and any sources of funding

Funding for the deployment of the AMI meters and gas modules originates primarily as an Edison funded capital project (the gas related components are funded by MichCon).

In late 2009, Edison submitted its Smart Grid Investment Grant ("SGIG") application under the US Department of Energy's topic area of "Integrated and/or Crosscutting Systems" as the SmartCurrents^{SM} program which integrates AMI, Smart Home and Smart Circuit technologies. The driver to the whole SmartCurrents^{SM} program was the effort undertaken by Edison to install and implement its AMI program. The mechanics of the grant are straightforward: The utility incurs expenses associated with the program, submits the necessary documentation to the US government, and then receives a fifty percent reimbursement from the government up to a pre-determined grant cap. The SmartCurrents^{SM} program scope covers approximately 600,000 of the total 2.6 million electric meters for Edison.

The following table depicts the total estimated cost of the completed project for the nearly 4.0 million endpoints.

(estimated $ in Millions)

Company	Total Plan	Expended to 12/31/11
Detroit Edison	**$447**	**$126**
MichCon	139	6
Total	**$586**	**$132**
DOE Grant	52	49
Total cash cost	**$534**	**$ 83**

(3) An estimate of the savings to be achieved by the deployment of smart meters

There are numerous cost savings and benefits associated with the installation of AMI as well as considerable improvements in the Company's ability to efficiently operate its electric system. The details are described below. (See also the direct testimony and exhibits of R. E. Sitkauskas in Case No. U-16472, pages 6-9 and Exhibit A-18)

a) Meter Reading – Automation of meter reading provides daily and on demand, accurate meter reads of each customer meter regardless of energy type. Edison has some 2.6 million electric meters to read every month of which about 10% are located inside of facilities or homes. AMI will eliminate the need to gain access for inside meter reads and thereby reduce meter reading costs. AMI can provide customers with daily reads that will further enhance the customer experience by eliminating miscellaneous and off-cycle reading of customer meters. Since installation, actual read rates for AMI regularly surpass 99% plus daily, regardless of weather. In fact, in conjunction with the remaining manual reads, Edison has exceeded its previous meter read rates since November of 2010. Prior to AMI, all manual meter reads rarely surpassed 96% actual meter read rates.

b) Bill Accuracy – With read rates over 99% for all meters every day, the estimated bills, often the source of customer concerns, are virtually eliminated. In addition, when this read rate is complemented by the accurate remote reads, issues of transposition are eliminated. Due to the elimination of estimates and the accurate reads, customer complaints in the areas where AMI is installed have fallen dramatically.

c) Theft and tampering notice – The system notes tampering at the meter any time it occurs. As a result, we will be able to receive tamper events at any time on any day. This is a significant advantage over our current monthly meter reader site review. In the Edison project implementation, theft and tampering processes are in the early stages. Edison is currently developing various reports and analysis techniques to identify specific theft events.

d) Occupational Safety & Health Administration (OSHA) recordable injury rate – Edison is very proud of their safety record to date. Besides reducing the OSHA rate for customer service meter reading, Edison has installed over 650,000 AMI smart meters without a single OSHA safety event.

e) Turn on/Turn off/Restore – This functionality, which has been proven to be very successful, allows Edison to reconnect customers remotely, speeding reconnections, a significant improvement in customer service. Disconnections in accordance with billing rules can be impacted equally. As Edison moves further into integration with the collection activity, the AMI smart meter technology has readily proved itself worthy. Later to come in 2012, the technology will be applied to customer requested move in and move outs, providing another means of satisfaction to customers who purchase homes. This feature also has a great level of satisfaction with our large apartment and student housing complexes where reconnects and disconnects are a regular occurrence and now can be accomplished over the air with no additional requirements from the landlords. Additionally, our community fire and police departments have inquired of us to use this switch when they are in route to a fire or situation. Edison will still send a crew but through the use of the remote disconnect switch we can assist the community fire and police departments and possibly may even save a life.

f) Outage Efficiency – With the systems' ability to report customer outages and restorations, the overall outage operation is enhanced tremendously. Although the system will not repair customer outages, the ability to receive timely information will aid the process. The outage efficiency feature is most important at the end of a storm. This integration is currently installed and maturing. Edison has used the technology to determine the correct location of outages to assist our dispatch operations. We are piloting a piece of this technology which allows the line crew when they complete their initial work, while at their truck, to send a signal (ping) to the meters. This will give the line crew, while still at the customer location, the information necessary to determine whether the customer has been restored.

Assuming that all the installations are completed for both electric and gas, the steady stated savings of AMI is currently estimated at approximately $65 million per year.

(4) An explanation of any other non-monetary benefits that might be realized from the deployment of smart meters

Several non-monetary benefits will be realized from the deployment of Edison's AMI program. Gains in Customer Satisfaction are at the forefront of the non-monetary benefits.

AMI smart meters will be able to record instances of voltage problems at the customer's location. This data will enhance the engineering design process of the electric infrastructure and assist in the electric problem solving at specific customer sites. In addition, providing virtually every customer an actual remote read on their power usage eliminates numerous customers read related issues. Calls concerning estimated bills, incorrect meter reads, and property damage by readers are virtually eliminated.

Customers will be able to view their daily and hourly energy usage through our secure online system. They can use this data to help make informed decisions regarding energy usage and to assist them in their energy conservation efforts.

Additionally, with AMI, the versatility of combining multiple customer sites with reads on the same day or even giving the customer their choice of billing dates will be possible.

Along with the ability to collect interval data, AMI smart meters will facilitate the availability of different rate options for customers. For example, if a residential customer decides to switch from traditional residential service to a time of use rate, the changes are completed over the air and do not necessitate a new meter, a field visit and most importantly, a customer interruption. This installation and data availability will also facilitate the flexibility for optional Energy Efficiency programs in the future. In addition, Edison has pilot rate options available to customers under its Dynamic Peak Pricing and Pre-Pay programs for customers with AMI smart meters.

Lastly, using the disconnect switch as discussed earlier, at the request of a police/fire call, may readily save lives and expedite the process of emergency response performing their duties.

By collecting this data, Edison is just beginning to explore how the data can be used by both customers and the utility to improve operations and provide energy management tools.

(5) Any scientific information known to the electric utility that bears on the safety of the smart meters to be deployed by that utility

Edison believes that AMI smart meters are safe and have been thoroughly studied. The Radio Frequency ("RF") emissions that occur when the meter is sending data are at very low levels, and according to leading research studies, do not cause negative health effects. It should be noted that standards for RF emissions have been developed by the federal government and all of the smart meters that Edison is installing fall well below these federal government standards for RF emissions.

The RF emissions from an AMI smart meter are similar to that emitted by a remote control or garage door opener device that is used often in everyday life and in considerably closer proximity to humans. Further, the RF emissions from AMI smart meters are remarkably less than those emitted by many other household devices such as a remote control for a TV, remote car entry, baby monitor, microwave oven, and cell phone. The meter manufacturer, Itron, as well as other independent external resources, have completed testing on the specific Itron AMI smart meter product that Edison is installing and have verified the low levels of RF emissions.

Additionally, The Edison Electric Institute ("EEI") has generated a series of Key Issues in perspective documents relative to:

- Smart Meters and Your Health
- Smart Meters and Data Privacy
- Smart Meters and Data Accuracy

See Appendix A for a summary of these reports and others reviewed by Edison.

(6) An explanation of the type of information that will be gathered by the electric utility through the use of smart meters

The following data will be collected from the AMI smart meters

- Accumulated Watt hour ("Whr") consumption readings
- Load profile hourly interval Whr and Volt Ampere hour ("VAhr") energy data
- Load profile 5-15 min. Whr and VAhr energy data (used for load research, commercial customers and voluntary SmartHome customer locations)
- Instantaneous voltage
- Gas module ccf readings (only in locations with a gas meter)
- Meter messages, events, alarms and network parameters

At no time will any customer specific data, like addresses, phone number, account status or social security numbers be transmitted by the AMI meter or gas module.

(7) An explanation of the steps that the electric utility intends to take to safeguard the privacy of the customer information so gathered

Safeguarding customer information has been paramount importance to Edison for the last 100 years and it will continue to be in the future. The technology does not weaken this safeguard but in many ways is more secure than other low-tech solutions. All of the data that is transmitted by AMI smart meters is encrypted from the onset and throughout the process.

The data collected from a AMI smart meter is the same data that is collected from an analog meter. The only difference is that the analog meter aggregates the data internally at the meter whereas the AMI smart meter transmits the data to be aggregated at Edison. The data collected from the AMI smart meter is energy use for the entire customer location and not data on individual appliances and devices.

The Company adheres to multiple internal policies and employs several methods to insure customer information is kept confidential.

a) The Company has a comprehensive confidentiality and privacy policy that applies to all employees of Edison as well as DTE Energy and its subsidiaries. This Policy also applies to any contractors, vendors or consultants performing work on behalf of DTE Energy and/or any of its subsidiaries.
b) Each employee must complete a Code of Conduct web based training course that instructs the employee on the proper uses and security of customer data and information.
c) A significant part of our core values is for all employees to follow the "DTE Energy Way". As part of this policy, customer privacy is defined as follows:
    i. "Our customers have come to trust us with their account information, records, and energy usage data. DTE Energy treats customer data as confidential. We will not release customer private information to third parties except when legally required, in the course of an investigation, or when the third party is performing services on behalf of the Company and, where required, has agreed to non-disclosure.
d) The "DTE Energy Way" policy also includes conduct standards such as:
    i. We will treat our customers with dignity and respect.
    ii. We will only use the information we receive about our customers for legitimate DTE Energy business purposes.
    iii. We will only access a customer account, record, or report when we have an authorized business or emergency response purpose for doing so.
    iv. We will strictly adhere to any applicable laws or regulations governing information sharing among DTE Energy companies."
e) The Company has implemented an online privacy policy. The policy may be accessed at the bottom of our web page "dteenergy.com" or at the following web link: http://www.dteenergy.com/privacyPolicy.html. This Privacy Policy applies to the DTE Energy Web site (dteenergy.com) as well as all other DTE Energy affiliates' sites, unless modified by a privacy policy on the respective DTE Energy affiliate site ("Affiliate Privacy Policy").

(8) Whether the electric utility intends to allow customers to opt out of having a smart meter

Edison's AMI program is beneficial for all customers. Edison is taking appropriate and reasonable measures to protect the privacy of our customer's data and the RF emissions from AMI smart meters exist at low levels that do not cause harm or negative health effects.

The overwhelming majority of our customers fully support AMI. However, given the small group of concerned customers, Edison is developing an opt-out program.

Although the detail for such a program has not been fully developed, it should be noted that "opt-out" customers will not receive the individual customer benefits of AMI. Their lack of participation will reduce the benefits of AMI for all customers and will subject customers electing to opt-out, to additional costs and make them ineligible for optional programs where an AMI smart meter is required.

Edison's major tenets of an opt-out program must consider: monthly meter reading costs, special field visit costs (which AMI could have eliminated), distribution management voltage detection, outage operations, customer billing options where an interval meter read is required, customer service billing system modifications to delineate the opt out customer from all AMI related benefits.

- The Company should be made whole for all incremental costs, the electing customers should bear the costs, and the opt out charges should be based on costs consistent with the provisions of PA 286, M.C.L. 460.6.

- The opt-out program shall not operate in a manner that contradicts or unreasonably interferes with the AMI benefits enjoyed by all other customers or negatively affect the reliability or operation of the electric system.

- Opt-out decisions must be initiated and made by individual customers and not by broader interest groups or municipalities on their behalf. Opting out will eliminate several individual customer benefits and conveniences and will subject the customer to additional charges, so permitting third party's to make this selection is inappropriate.

Edison intends to file its opt-out program to address specific details as part of its next general rate case filing. If, however, the Commission decides to order a separate proceeding to address the opt-out procedures and associated costs, then Edison would submit a tariff filing pursuant to such a Commission order.

(9) How the electric utility intends to recover the cost of an opt out program if one will exist

Incremental costs will be charged to the customer of record on their monthly bill once the design of the opt-out program is approved by the Commission. Pursuant to legislation adopted in 2008 (PA286), by October 2013, Utilities are required to eliminate any subsidy's that may be included in customer rates. Thus, customers are required to pay for service, the cost of providing that service.

Therefore, a customer choosing Edison's opt-out tariff provision will be responsible for all costs associated with that choice and will not be absorbed by other customers accepting AMI smart meters.

Respectfully Submitted

THE DETROIT EDISON COMPANY

Dated: March 16, 2012

Appendix A

Attachment 1: "Analysis of Radio Frequency Exposure Associated with Itron OpenWay® Communications Equipment," March 2011

> In this report comparisons are made to other household devices like cell phones, computers and microwaves. From page 7,
>
> > “The data indicates that the Itron OpenWay smart meters present an extremely low level of RF exposure when compared to the regulatory limits established for safe operations.”

Attachment 2: "Wireless Transmissions: An Examination of OpenWay® Smart Meter Transmissions in 24-Hour Duty Cycle," March 2011

> This report presents the test results of 7,000 Itron OpenWay meters. The full report is attached but some highlighted excerpts follow:
>
> > Page 4
> >
> > “Figure 1 (on page 4) shows that out of 6,865 meters sampled, 97.95% of the meters transmitted for less than 100 seconds in the 24 hour period (duty cycle of less than 0.12%per day).”
> >
> > Page 6
> > “OpenWay smart meters are advanced highly efficient devices. They are able to communicate a large amount of metering and event data in short burst throughout a 24-hour period (each transmit burst is less than 150mSec). The worst case meter in the sample population was essentially silent (not transmitting) for over 99.40% of the day while the average meter was silent 99.94% of the day. In terms of FCC regulation for Maximum Permissible Exposure (MPE) limits, the worst case meter was less than 0.09% of the limit mandated by the FCC (0.00051mW/cm^2 vs. 0.61 mW.cm^2) with the average meter less than 0.009% of the FCC limit (0.000053 mW/cm^2) …
> >
> > Itron takes all concerns about RF exposure very seriously and continuously strives to ensure its products meet or exceed FCC guidelines and regulations. In the case of OpenWay smart meters, Itron dramatically exceeds these mandates with a product that generates only a very small fraction of the FCC limits for RF exposure.”

Attachment 3: "Smart Meters and Smart Systems: A Metering Industry Perspective," Edison Electric Institute (EEI), Association of Edison Illuminating Companies (AEIC) and Utilities Telecom Council (UTC), March 2011

From the Executive Summary:

> "However, studies show the RF exposures of Smart Meters are lower compared to other common sources in the home and operate significantly below Federal Communications Commission (FCC) exposure limits."

Attachment 4: "A Discussion of Smart Meters And RF Exposure Issues," Edison Electric Institute (EEI), Association of Edison Illuminating Companies (AEIC) and Utilities Telecom Council (UTC), March 2011

From the Executive Summary:

> "Accordingly, this document explains that the RF exposures of Smart Meters are lower compared to other common sources in the home and operate significantly below Federal Communications Commission (FCC) exposure limits."

Attachment 5: Edison Electric Institute (EEI) - Smart Meters and Your Health

Attachment 6: Edison Electric Institute (EEI) – Smart Meters and Data Privacy

Attachment 7: Edison Electric Institute (EEI) - Smart Meters and Data Accuracy

The above three Edison Electric Institute (EEI) reports give a brief description of issues surrounding smart meters.

In Addition: The following documents containing useful information can be found at the web locations identified below:

"EPRI 2010 Technical Report – An Investigation of Radiofrequency Fields associate with the Itron Smart Meter (222 page full report)"

http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001021126&RaiseDocType=Abstract_id

Results and findings page v

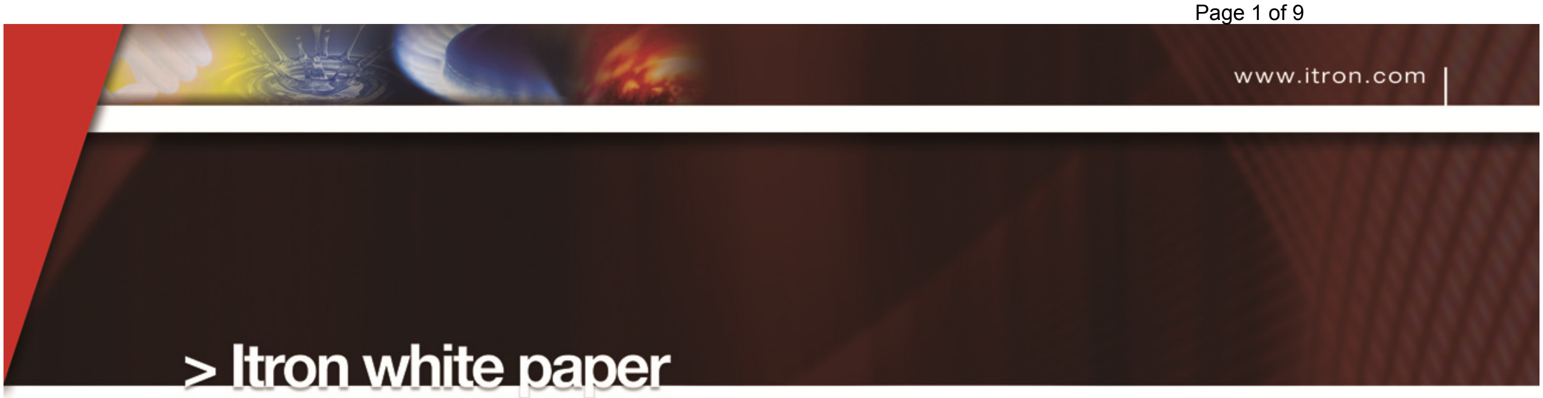
> "The results indicate that RF field from the investigated smart meter are well below the maximum permitted exposure (MPE) established by the Federal Communications Commission (FCC)."

"No Health Threat from Smart Meters," Utilities Telecom Council, Q4 2010

http://www.utc.org/utc/no-health-threat-smart-meters-says-latest-utc-study

Report from the UTC finding that there are no negative health effects caused by the Itron Smart Meter (page 5)

> "In summary, there is no known long term health effect from exposure to RF energy at levels below those designated by the FCC. This energy is all around and the energy associated with smart meters is far less than those of other common services and equipment."



Analysis of Radio Frequency Exposure Associated with Itron OpenWay® Communications Equipment

Mike Belanger
Product Line Manager

Itron

Itron

Overview

This document provides information regarding radio frequency (RF) energy exposure from Itron's OpenWay wireless communications equipment, which is used by utilities for smart metering communications and other utility applications. The OpenWay equipment has been certified by the Federal Communications Commission (FCC) and Industry Canada (IC).

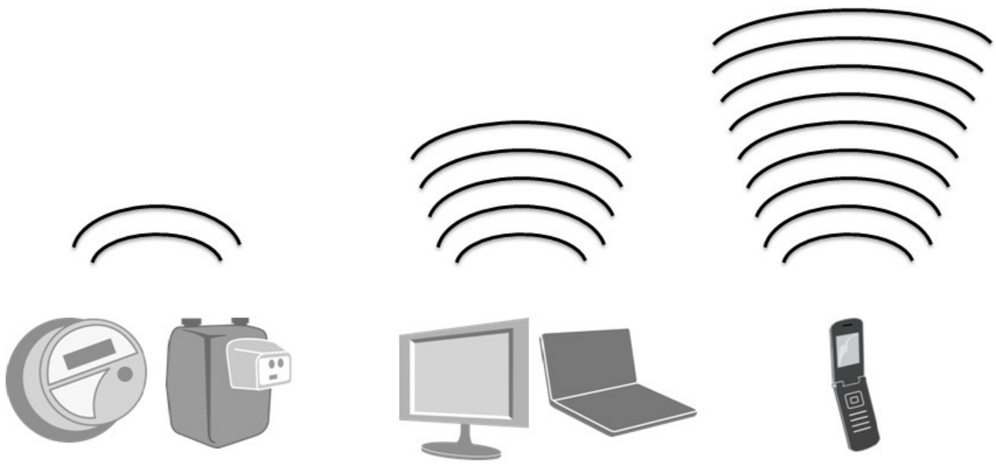
Introduction

We live in a world where RF energy is all around us. It plays a critical role in the communications systems that we depend on every day, such as police and fire radio systems and pagers, radio and television broadcasts, and cellular telephones. Many of the conveniences we've grown accustom to in our homes, such as cordless phones, wireless LAN (WiFi), and microwave ovens also utilize and emit RF energy.

This same technology is used by utilities and energy service providers to team with consumers to make our energy grid more efficient and reliable, and to optimize our use of limited energy resources. By providing a two-way communications network between the meters and the utility, the RF technology establishes the critical foundation for the realization of the Smart Grid.

It is important to recognize the relative amounts of RF energy the smart meters contribute to the existing RF environment. The chart below provides an approximate comparison of the various sources found in and around typical households.

RF Energy Comparison



Itron recognizes that there are concerns related to the health effects of exposure to RF energy and monitors the various organizations researching this topic. Additionally, Itron ensures that our products are compliant with the established regulatory requirements related to RF emissions.

Regulatory Compliance

The FCC recently revised a document detailing how to measure or calculate levels of RF radiation. The document titled "*OET Bulletin 65 Edition 97-01, Evaluating Compliance with FCC guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*" may be found at www.fcc.gov/oet/rfsafety. Additionally, in June 2001, the FCC released "*OET Bulletin 65 supplement C Edition 01-01*" (known as OET-65C), which provides further guidance on determining compliance for portable and mobile devices.

The FCC has completed a rulemaking titled "*Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation*" (FCC Report and Order, ET Docket 93-62). This document combines standards developed by ANSI and the National Council on Radiation Protection and Measurement (NCRP). The new rules have been incorporated into Title 47 of the Code of Federal Regulations (Parts 1, 2, 15, 24, and 97). These rules dictate the level of compliance necessary to meet the standards.

The Industry Canada has also published an RSS-102 standard that addresses RF exposure issues on the territory of Canada. This standard references to the Safety Code 6 from Health Canada: "*Limits of Human Exposure to Radiofrequency Electromagnetic fields in the Frequency Range from 3 kHz to 300 GHz.*"

Types of RF Exposure and Maximum Permissible Exposure Limits

The revised ANSI standards, the NCRP Report and the FCC Rules and Guidelines define two types of exposure to RF energy:

> Occupational / Controlled Exposure when persons are exposed as a consequence of their employment and they have been made fully aware of the potential for exposure and can exercise control over their exposure.
>
> General Population / Uncontrolled Exposure when persons who are exposed to RF fields may not be made fully aware of the potential for exposure or cannot control their exposure.

The standards specify the Maximum Permissible Exposure (MPE) levels as the strength of electromagnetic field or the equivalent power density associated with this field to which a person may be exposed without harmful effect.

The FCC defines the Maximum Permissible Exposure (MPE) levels according to the following equations:

> Occupational MPE: Exposure *[mW/cm²]* = Frequency *[MHz]* / 300
>
> General Population MPE: Exposure *[mW/cm²]* = Frequency *[MHz]* / 1,500

The MPE limits are dependent on the frequency of the transmitting device and allow for higher levels of exposure for occupational/controlled environments.

The Itron OpenWay communications equipment is assessed against the more stringent General Population Exposure limits.

An important feature of the regulatory guidelines is that exposure, in terms of power density, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure. The averaging time is defined as six minutes for occupational/controlled exposure and 30 minutes for general population/uncontrolled exposure.

Itron OpenWay Wireless Communication Equipment under Consideration

The Itron OpenWay wireless communication equipment operates in the Industrial, Scientific and Medical (ISM) bands at frequencies from 902 MHz to 928 MHz and from 2,400 MHz to 2,483 MHz. Also, a small number of devices incorporate wireless modems operating at frequencies 824-849 MHz and 1,850-1,910 MHz designated for the cellular operators (Cell Relays constitute about 1% of all the OpenWay wireless devices and can be mounted on poles or as part of a meter). This analysis will focus on the OpenWay CENTRON® smart meter.

Itron

The following table reflects the data contained within the Certification Exhibits for FCC Rule Part: 15.247 for Itron OpenWay Smart Meters:

FCC ID	SK9AMI-xx
FCC Rule Part	15.247
Classification	Digital Transmission System Transmitter Frequency Hopping Spread Spectrum Transmitter
Device Category	Mobile
Environment	General Population / Uncontrolled Exposure
Exposure Conditions:	Greater than 20 centimeters (8 inches)
Frequency bands	RF LAN 902 – 928 MHz ZigBee 2,400 – 2,483.5 MHz
Transmitter Power*	RF LAN 24.83dBm (304.09 mW) at 902.25 MHz ZigBee 18.94 dBm (78.34 mW) at 2,475 MHz
Antenna Gain*	RF LAN 2.2 dB (1.660 times) at 902.25 MHz ZigBee 3.8 dB (2.399 times) at 2,475 MHz

*Values have been updated to reflect the latest meter hardware release (FCC ID: SK9AMI6)

The duty cycle (or amount of time a device is active in any given time period) will have a significant impact on the long term exposure levels for a device. The Itron OpenWay smart meters are actively transmitting a very small portion of the time. The maximum duty cycle for each transmitter is listed below:

Max Duty Cycle (over period of 30 minutes)	RF LAN ZigBee	5% 1%

For the Itron OpenWay smart meters wireless communication equipment, the MPE limits for continuous exposure are as follows:

Frequency	**MPE level**	
	Occupational	***General population***
RFLAN (902 MHz)	3.0 mW/cm^2	0.6 mW/cm^2
Zigbee (2,400 MHz)	8.0 mW/cm^2	1.0 mW/cm^2

Calculation of RF emissions

The FCC MPE levels represent the guaranteed safety limits based on the thermal effect of continuous RF radiation.

The FCC guidelines define the following equation to calculate the power density of RF radiation under far-field conditions:

$$\text{Power\_Density } [mW/cm^2] = \frac{\text{Transmitter\_Power } [mW] \times \text{Antenna\_Gain } [times]}{(4 \times \text{pi} \times \text{Distance } [cm] \times \text{Distance } [cm])}$$

The 1992 ANSI/IEEE standard specifies that 20 cm (~ 8 inches) should be the minimum separation distance where reliable field measurements to determine adherence to MPEs can be made.

It is important to note that the Itron's equipment operates in short bursts randomly distributed over prolonged period of silence (5% and 1% duty cycles). According to the rules, the MPE levels for interrupted transmission should be calculated by averaging the active time over interval of 30 minutes in the case of General Population exposure or six minutes in the case of occupational exposure.

A comparison of the MPE from the Itron OpenWay smart meter's transmitters to the General Population MPE limits with the duty cycles accounted for is shown in the table below:

Transmitter	MPE Limit	MPE	Margin
RF LAN (902MHz)	0.6 mW/cm^2	0.0050 mW/cm^2	**0.833%** of the limit
ZigBee (2,405MHz)	1.0 mW/cm^2	0.00037 mW/cm^2	**0.037%** of the limit

The data indicates that the Itron OpenWay smart meters present an extremely low level of RF exposure when compared to the regulatory limits established for safe operation.

Itron

Summary

The RF power densities for OpenWay communications calculated according to the recommended method are only a small fraction of the Maximum Permissible Exposure limits.

Itron will continue to monitor the regulatory standards and research related to RF Exposure to verify that its products are in compliance with all applicable legal requirements.

Additional Information

Additional information from the World Health Organization

- *World Health Organization (WHO) Fact Sheet*
- *Electromagnetic Fields*
- *International EMF Project*

Information from the Federal and Drug Administration (FDA)

- *Radiation-Emitting Products*
- *Interference with Pacemakers and Other Medical Devices*

Information from the Federal Communications Commission (FCC)

- *Radio Frequency Safety*

Information from the California Council on Science and Technology (CCST)

- *Health Impacts of Radio Frequency from Smart Meters*

Information from Itron

- Itron Radio Frequency Resource Center

About Itron

At Itron, we're dedicated to delivering end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Our company is the world's leading provider of smart metering, data collection and utility software systems, with nearly 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water. Our offerings include electricity, gas, water and heat meters; network communication technology; collection systems and related software applications; and professional services.

To realize your smarter energy and water future, start here: www.itron.com.

Itron Inc.
Corporate Headquarters
2111 North Molter Road
Liberty Lake, Washington 99019
U.S.A.
Tel.: 1.800.635.5461
Fax: 1.509.891.3355

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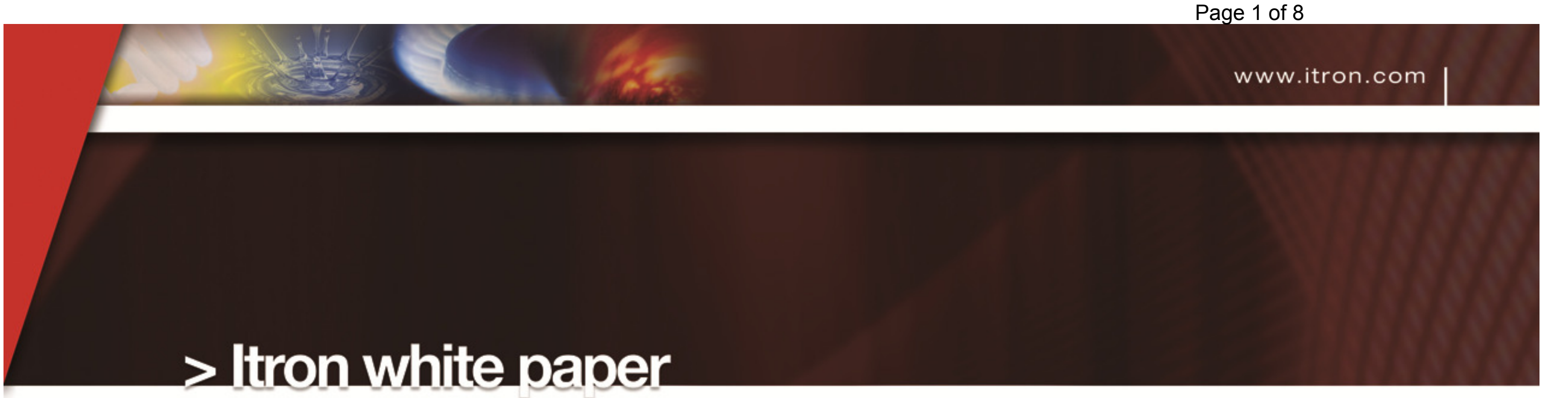

Wireless Transmissions:

An Examination of OpenWay Smart Meter Transmissions in a 24-Hour Duty Cycle

Jeff French
Applications Engineer

Mike Belanger
Product Line Manager

Itron

Itron

Overview

This document is a supplement to the paper titled "Analysis of Radio Frequency Exposure Associated with Itron OpenWay® Wireless Communication Equipment." A key consideration for evaluating RF exposure from Itron smart meters is the duration of exposure—or how often the radios are transmitting. This report summarizes data collected from a representative large-scale OpenWay deployment over a typical 24-hour operational period, providing empirical data that quantifies the percentage of time a meter's radios are active (also known as the meter's "duty cycle").

Introduction

Itron OpenWay CENTRON® meters utilize wireless communications to transmit and receive data between meters and a collection device (such as a Cell Relay). To better characterize the level of RF emissions emitted during this data collection process, a study was conducted by Itron to determine the amount of time, within a 24-hour window, a meter's radio is actively transmitting.

The data collected by Itron represented approximately 7,000 meters in the sample network (see *Note #1*), over a 24-hour period, in order to determine the percentage of time that the meter was transmitting (again, the duty cycle). A read of the meter's transmit counters (bytes transmitted) was captured at noon on Wednesday, December 1, and again at noon on Thursday, December 2. To determine the total amount of data transmitted in that 24-hour period, the numbers from December 1 were subtracted from the numbers on December 2.

For example, if Meter X's transmit counter was at 10234342 when the reading was taken on December 1, but by December 2 the counter was up to 10432514, we can deduce that in 24 hours Meter X transmitted 198,172 bytes. While that figure is useful, it does not tell us what portion of the day that the meter was actually transmitting. To determine that figure, we must first convert the number of bytes to bits by multiplying by eight (198,172 x 8 = 1,585,376).

Next, because we know that these meters transmit data at a rate of 19,200 bits per second (see *Note #2*), we divide our total by 19,200 (1,585,376 / 19,200 = 82.57 seconds) to determine that the number of seconds the meter was actually transmitting was 82.57 seconds in 24 hours. Finally, to calculate the duty cycle, we must divide the number of active seconds by the number of seconds in a day (82.57/86,400 = 0.09557%). Therefore the daily duty cycle of meter X is ~0.1%.

Results

The following graphs and table summarize the results of the data gathered.

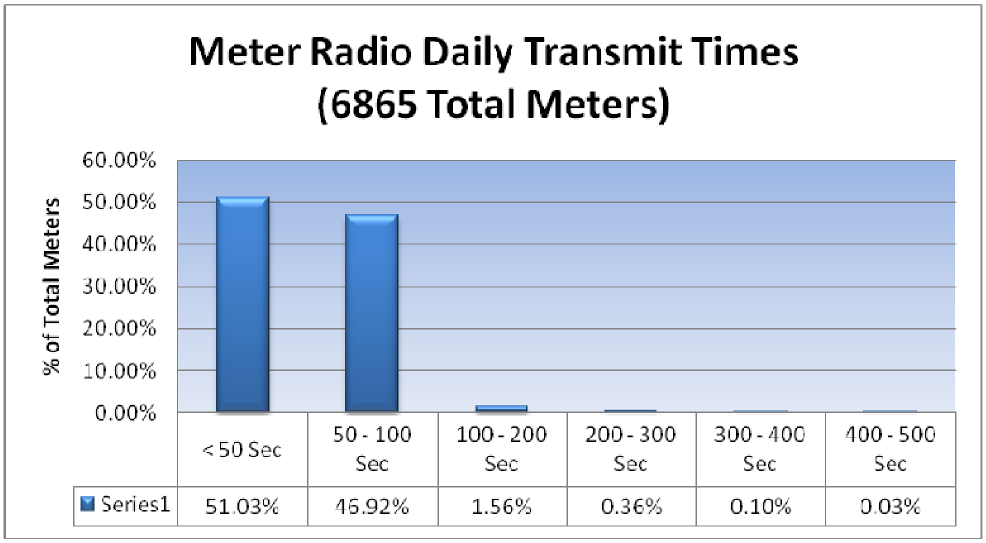

Fig. 1 Daily Transmit Times

Figure 1 shows that out of the 6,865 meters sampled, 97.95% of the meters transmitted for less than 100 seconds in the 24 hour period (duty cycle of less than 0.12% per day).

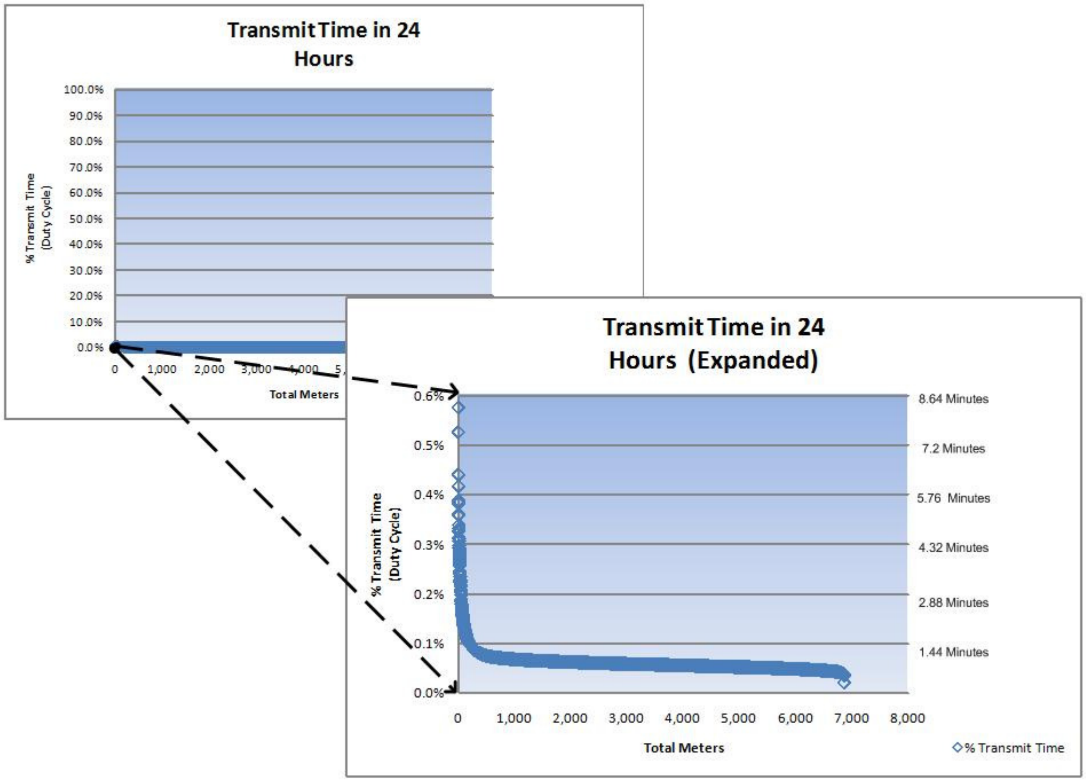

Fig. 2 Percentage of Transmit Time

Figure 2 represents a scatter plot of all meters' transmit times. Because the meters transmit for such a small percentage of the time, the first view appears as a solid blue line resting on the x-axis (below 1%). In the expanded view it is possible to see the maximum daily duty cycle is less than 0.6% (transmit time less than 8.64 minutes/day). This view also shows that 98% of the meters have a daily duty cycle of less than 0.1% (transmit time less than 1.44 minutes/day).

	Duty Cycle	Time
Mean	0.06%	53.14 seconds per day
Maximum	0.58%	497.8 seconds per day
Minimum	0.02%	18.31 seconds per day
Median	0.06%	49.81 seconds per day

Fig. 3 Transmit Time Statistics

The table above (*Figure 3*) shows that meter emission times vary, but even the maximum transmission represents less than 1% of the 24-hour period. Median and Mean (or average) times are relatively close together, which indicates the absence of many meters on the extreme ends of the range.

The sample period that was selected represents a day of higher-than-normal activity for the sample network. During this time, in addition to the two normally scheduled daily meter data reads, there were two crucial updates being transmitted to every endpoint on the network—one for an adjustment for Daylight Savings Time and the other was a crucial firmware update. In a typical day with no updates taking place, the numbers would more than likely be even lower.

Conclusion

OpenWay smart meters are advanced, highly-efficient devices. They are able to communicate a large amount of metering and event data in short bursts throughout a 24-hour period (each transmit burst is less than 150mSec). The worst case meter in the sample population was essentially silent (not transmitting) for over 99.40% of the day while the average meter was silent 99.94% of the day. In terms of FCC regulations for Maximum Permissible Exposure (MPE) limits, the worst case meter was less than 0.09% of the limit mandated by the FCC (0.00051 mW/cm^2 vs 0.61 mW/cm^2) with the average meter less than 0.009% of the FCC limit (0.000053 mW/cm^2 vs 0.61 mW/cm^2). [With the duty cycle is accounted for, See *Note #3*]

This empirical field data further refines our estimations for maximum duty cycle of Itron OpenWay meters. When accounting for the variations in cell size and data requests, our expectations for maximum duty cycle are 1% (14.4 min/day). The previous estimate prior to this field data was 5% duty cycle.

Itron takes all concerns about RF exposure very seriously and continuously strives to ensure its products meet or exceed FCC guidelines and regulations. In the case of OpenWay smart meters, Itron dramatically exceeds these mandates with a product that generates only a very small fraction of the FCC limits for RF exposure.

Note #1:

The sample meter data was taken from one of Itron's large-scale, operational network customers. It is representative of the OpenWay smart grid solution. There were 6,865 meters in the population sample, spread across 10 cells (average cell size of ~687 meters). The data for the Cell Masters is included in this analysis.

Note #2:

The 19,200 Kbps transmit rate represents the 1G RFLAN currently deployed at this site. Itron has released the 2G RFLAN (with SR3.0) which increases the transmit rate to 153 Kbps and added sub-timeslot efficiencies. For networks deployed with or moving to 2G RFLAN, the transmit efficiency will be greatly increased, so that with the same amount of data passing through the network, the amount of radio transmit time will significantly less.

Note #3:

The FCC has defined the Maximum Permissible Exposure (MPE) as the strength of electromagnetic fields or the equivalent power density associated with this field to which a person may be exposed without harmful effect. For the general population (individuals who might potentially be exposed to RF energy without their knowledge), the limits are set using the following equation:

General Population MPE: Exposure *[mW/cm²]* = Frequency *[MHz]* / 1,500

The MPE limits for continuous exposure by an Itron OpenWay smart meter is 0.61 mW/cm^2. These limits are based on the thermal effect of continuous RF radiation. To calculate the power density the following equation is used:

$$\text{Power\_Density } [mW/cm^2] = \frac{\text{Transmitter\_Power } [mW] \text{ x Antenna\_Gain } [times] \text{ x Duty Cycle}}{(\text{ 4 x pi x Distance } [cm] \text{ x Distance } [cm]\text{ })}$$

In the population sample discussed, the worst case meter had a duty cycle of 0.58% (0.0058). With power density of 0.088 mW/cm^2 during transmission, the resulting power density with duty cycle is 0.00051 mW/cm^2. When compared to the MPE limit set by the FCC (0.61mW/cm^2) this meter was at 0.084% of the allowable amount. The average meter had a duty cycle of 0.06% (0.0006). With power density of 0.088 mW/cm^2during transmission, the resulting power density with duty cycle is 0.000053 mW/cm^2. When compared to the MPE limit set by the FCC (0.61mW/cm^2) this meter was at 0.009% of the allowable amount.

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Corporate Headquarters
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Fax: 1.509.891.3355

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Smart Meters and Smart Meter Systems: A Metering Industry Perspective

An EEI-AEIC-UTC White Paper

A Joint Project of the EEI and AEIC Meter Committees

March 2011

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Web site: www.eei.org

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1: Introduction

The following industry discussion of Smart Meters and Radio Frequency (RF) Issues was prepared by the member company representatives from the following organizations.

Edison Electric Institute (EEI)

The Edison Electric Institute (EEI) is the association of U.S. Shareholder-Owned Electric Companies. Our members serve 95 percent of the ultimate customers in the shareholder-owned segment of the industry, and represent approximately 70 percent of the U.S. electric power industry. Organized in 1933, EEI works closely with all of its members, representing their interests and advocating equitable policies in legislative and regulatory arenas.

The Association of Edison Illuminating Companies (AEIC)

AEIC was founded by Thomas Edison and his associates in 1885. AEIC encourages research and the exchange of technical information through a committee structure, staffed with experts from management of member companies.

AEIC's members are electric utilities, generating companies, transmitting companies, and distributing companies – including investor-owned, federal, state, cooperative and municipal systems – from within and outside the United States. Associate members include organizations responsible for technical research and for promoting, coordinating and ensuring the reliability and efficient operation of the bulk power supply system.

AEIC's Six Technical Committees are: Load Research, Meter and Service, Power Apparatus, Power Delivery, Power Generation and Cable Engineering. AEIC also provides highly valued literature on load research and underground cable specifications and guidelines.

Utilities Telecom Council

The Utilities Telecom Council (UTC) is a global, full-service trade association dedicated to creating a favorable business, regulatory, and technological environment for members. Founded in 1948, UTC has evolved into a dynamic organization that represents the broad communications interests of electric, gas, and water utilities; natural gas pipelines; other critical infrastructure entities and other industry stakeholders. Visit www.utc.org for more information on UTC and its services.

The purpose of this paper is to give an overview of the Smart Meter and Smart Meter Systems; how they are planned, certified, deployed, operated and maintained. It emphasizes these processes, as well as applicable standards, and due diligence used by utilities to assure the accuracy, integrity, security, strength and safety of this current technology. Also discussed is the role of the metering professionals in these projects and the Smart Meter's position in the national Smart Grid initiative.

While this paper highlights and discusses many of the more prominent approaches and processes used in deploying, operating, and maintaining Smart Meter systems, it does not attempt to describe or discuss all existing or potential processes or industry best practices. The activities and practices discussed throughout this paper are used to help define a broad range of factors that should be considered in planning and deploying Smart Meter Systems. Significantly, each Smart Meter project has a different set of demographics and assumptions, and should be designed to meet the needs of the specific utility and its customers.

Accordingly, this paper is presented as a resource for understanding and applying Smart Meter Technologies and Systems.

2. Executive Summary

Smart Meters and Smart Meter Systems are being deployed throughout North America, and utilities are continuing their efforts to improve grid reliability and promote energy efficiency while providing improved services to their customers. However, concerns have been raised regarding not only the accuracy, security and integrity of these meters, but also with respect to the potential impacts of radio frequency (RF) exposure on the public. Hence, this paper provides a basic overview for understanding how the electric utility industry seeks to ensure the appropriate level of accuracy, safety, and security. It also makes evident that before being accepted and deployed Smart Meters must meet a number of national standards and comply with state and local codes designed to ensure proper operation, functionality and safety.

Meter Accuracy

While there are technological differences between Smart Meters and older mechanical metering devices,[1] the electric industry exercises the same due diligence and precision for ensuring the accuracy of Smart Meters as it has to older mechanical metering devices for revenue billing application. The accuracy of Smart Meters, both in development and practice, has been confirmed to improve on the older electro-mechanical meter technology. All meters, regardless of technology and design, are required to meet national standards such as ANSI C12 for meter accuracy and operation before being installed.

Radio Frequency (RF) Exposure

Several Smart Meter Systems operate by transmitting information wirelessly. However, this has raised some concern about the health effects of wireless signals on electric consumers and the general public. However, studies show the RF exposures of Smart Meters are lower compared to other common sources in the home and operate significantly below Federal Communications Commission (FCC) exposure limits.[2] Additional discussions explain how the location, distance from the transmitter, shielding by meter enclosures, attenuation of building materials, direction of RF emissions, and transmit duty cycle significantly reduce exposure to consumers. It also includes a review of the conclusions of several Smart Meter RF studies and actual measurements of Smart Meter RF emissions to support this conclusion. Other observations included are:

- All smart meter radio devices must be certified to the FCC's rules.
- Tests simulating multi-family metering locations containing several meters in close proximity have shown RF exposure levels dramatically less than FCC limits.
- The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects.
- Exposure levels drop significantly (1) with the distance from the transmitter, (2) with spatial averaging, and (3) in living spaces due to the attenuation effects of building materials.

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[1] See Section 3, Overview of Smart Meters and Smart Meter Systems.

[2] See Section 6. Smart Meter System Issues

- Due to shielding of the meter enclosure and signal patterns, RF exposure from the rear of a metering location is nominally 10 times less than in front of the meter and dramatically below FCC limits, not including the spatial averaging and building material attenuation reductions.[3]
- For measurement and calculation purposes some studies use a 100% duty cycle parameters. However, the maximum operational Duty Cycle for Smart meter systems is less than 50% to prevent message traffic congestion and collisions. The typical Duty Cycles for Smart Meter Systems is between 1% and 5%.
- An RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating Smart Meter would result in Smart Meter RF exposure 125 to 1250 times less than the cell phone.[4]
- In test environments simulating operational conditions, for power (250 mWatt - 2 Watt), duty cycle (2%-5%) at close distance (1 foot) from in front of the transmitter, Smart Meters produce very low RF exposure to the consumer, typically well under 10 % of the FCC exposure regulations.

In Addition, before utilities accept and deploy Smart Meters, these devices must meet a number of national standards and comply with state and local codes designed to ensure proper operation, functionality and safety. In particular, Smart Meter and Smart Meter installations are typically designed to conform with and certified to comply with: [5]

- *ANSI C12 .1, 12.10, and 12.20* standards for accuracy and performance
- *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability"*
- FCC standards for intentional and unintentional radio emissions and safety related to RF exposure, *Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]*.
- Local technical codes and requirements
- Utility specific and customer beneficial business and technical requirements

The electric utility industry is continuously developing standards and guidelines to improve the safety, accuracy and operability of meters and associated metering devices. An example of these continuing improvement is *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability"* released in September 2009 to support the needs of developing the Smart Grid.

Finally, manufactures conduct complete performance and life cycle testing for all meter types and for major design changes to existing meter types, including hardware and firmware. Once the testing is successfully completed, the Smart Meter System components are utility or third party certified for production and purchase. Furthermore, after certification and purchasing, the utility materials acceptance process to evaluate each shipment of equipment for quality and compliance to specification. Completion of this process by utilities allows for receipt of equipment for field installation.

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[3] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[4] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

[5] This list is not exhaustive, and there may be other sets of rules/standards/requirements not reflected but applicable.

Security

Clearly, security and integrity of customer meters has been and continues to be a major focus by utilities and vendors. In this regard, a number of efforts by government and industry have started to address potential security risks. For example, a comprehensive set of cyber security guidelines published by the National Institute of Standards and Technology (NIST), and explains that endpoint and system vendors have been asked to comply with new requirements to address remote access, authentication, encryption, and privacy of metered data and customer information.

The deployment of a Smart Meter System begins with selection of the technology and the planning for installation, operation and maintenance. Utilities have integrated within the deployment process many elements of management, control, and compliance to support successful project implementation. The In-Service testing process is an integral part of a utility's due diligence for measurement accuracy of its meters. Utilities are designing appropriate transition and new post deployment testing plans to meet both local regulatory requirements and their business needs for post deployment operations.

Utility Metering Services operations are responsible to ensure the accurate, precise, reliable and robust operations of the revenue billing meters and support devices. With the significant increase of new measurement technologies and integration of communication systems into basic meters, metering operations will be challenged both technically and operationally in the near and long term. The emphasis on metering operations in utilities will increase as more sophisticated billing and measurement systems are developed, designed and deployed.

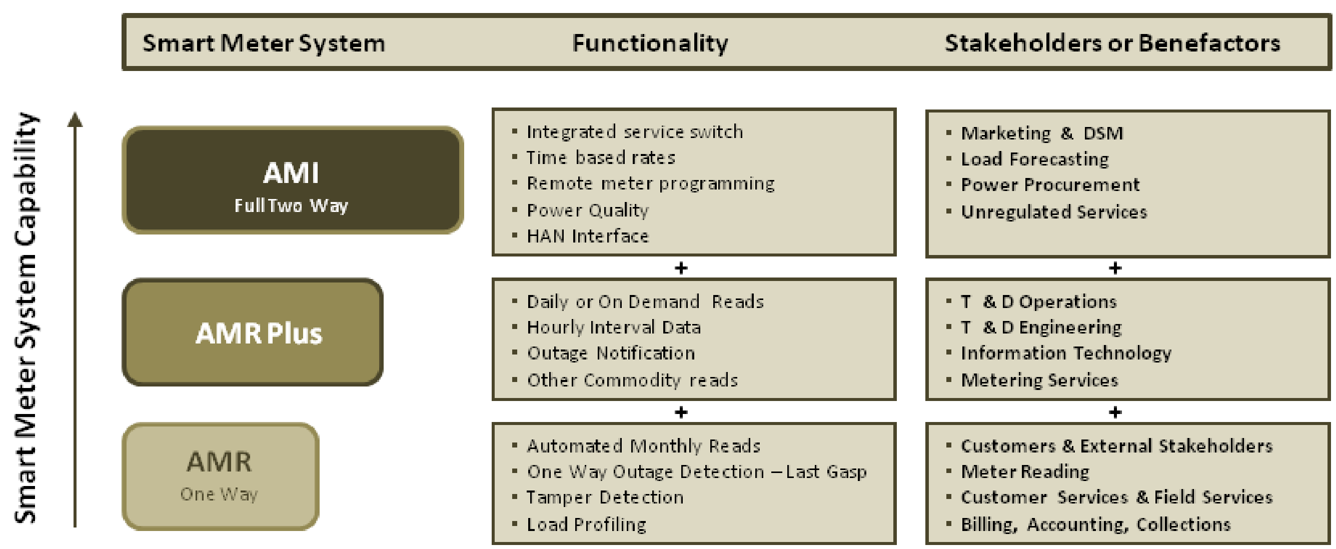
3. An Overview of Smart Meters and Smart Meter Systems

3.1 Definition of Smart Meter and Smart Meter Systems

Smart Meters are electronic measurement devices used by utilities to communicate information for billing customers and operating their electric systems. For over fifteen years electronic meters, have been used effectively by utilities in delivering accurate billing data for at least a portion of their customer base. Initially, the use of this technology was applied to commercial and industrial customers due to the need for more sophisticated rates and more granular billing data requirements. The use of electronic meters came into service to the largest customers of the utility and over time gradually expanded to all customer classes. This migration was made possible by decreasing cost of the technology and advanced billing requirements for all customer classes.

The combination of the electronic meters with two-way communications technology for information, monitor, and control is commonly referred to as Advanced Metering infrastructure (AMI). Previous systems, which utilized one-way communications to collect meter data were referred to as AMR (Automated Meter Reading) Systems. AMI has developed over time, from its roots as a metering reading substitute (AMR) to today's two-way communication and data system. The evolution from AMR to AMI is shown in figure 1 with lists of stakeholders and benefactors for each step in Smart Meter evolution.[6]

Figure 1 – Smart Meter Technology Evolution



[6] Note: All functionality and stakeholder interests are additive, progressing up the chart

Not until the Smart Grid initiatives were established were these meters and systems referred to as “Smart Meters and Smart Meter Systems”. Hence, the present state of these technologies should be more appropriately referred to as “an evolution, not a revolution” because of the development and use of Smart Meter technology and communications over the last fifteen years. The combined technologies are also required to meet national standards for accuracy and operability essential in the industry.

Although the Smart Meters are relatively new to the utility industry, they are treated with the same due diligence and scrutiny associated with electronic meters and older electromechanical counterparts. These meters have always met or exceeded national standards such as American National Standards Institute (ANSI) C12.1 for meter accuracy and design. In addition, equipment used to certify meter performance must be traceable to the National Institute of Standards and Technologies (NIST), a federal agency that works with industry to properly apply technology and measurements.

Other standards in use for the Smart Meter installations include National Electric Code (NEC) for home electrical wiring, National Electrical Manufacturers Association (NEMA) and Underwriters Laboratories (UL) for enclosures and devices, and National Electric Safety Code (NESC) for utility wiring. Through the leadership of utility metering professionals and metering manufacturers, the meticulous and deliberate development of these solid state electronic measurement devices has resulted in meter products that have advanced functionality, are stable and have tighter accuracy tolerances, and are more cost effective for advanced features than the legacy electro mechanical technologies.

3.2 Smart Meter System Benefits

The benefits of Smart Metering installations are numerous for many different stakeholders of the systems. The table below mentions some of the major benefits for utility stakeholders.

Stakeholder	Benefits
Utility Customers	• Better access and data to manage energy use • More accurate and timely billing • Improved and increased rate options • Improved outage restoration • Power quality data
Customer Service & Field Operations	• Reduced cost of Metering reading • Reduced trips for off-cycle reads • Eliminates handheld meter reading equipment • Reduced call center transactions • Reduced collections and connects/disconnects
Revenue Cycle Services - **Billing, Accounting, Revenue Protection**	• Reduced back office rebilling • Early detection of meter tampering and theft • Reduced estimated billing and billing errors
Transmission and Distribution	• Improved transformer load management • Improved capacitor bank switching • Data for improved efficiency, reliability of service, losses, and loading • Improved data for efficient grid system design • Power quality data for the service areas
Marketing & Load Forecasting	• Reduced costs for collecting load research data

Stakeholder	Benefits
Utility General	• Reduced regulatory complaints • Improved customer premise safety & risk profile • Reduced employee safety incidents
External Stakeholders	• Improved environmental benefits • Support for the Smart Grid initiatives

3.3 The Role of Utility Metering Operations

Metering Services operations in utilities have traditionally been tasked with providing customer billing measurement and have been responsible for accuracy, precision, and robust operations of the meters and support devices. Using a national system of standards, formal quality processes, utility best practices, and a dedicated sense of purpose, utility metering professionals have strived to produce the best system for billing utility customers in the global electric industry. In joint partnership with meter and communications manufacturers, they have driven the development of electronic metering and metering communications to deliver the top notch Smart Metering Systems available in the marketplace today.

For successful Smart Meter projects, Metering Services operations are an integral part of the project planning, deployment and maintenance of the systems. Their contributions in these areas of the process are required and fundamental to the project success. The most important contributions include:

- Development of the Business and Technical requirements of the Systems
- Participant of the technology selection team
- Certification of the system meters and devices
- Acceptance of the incoming production products
- Development of safe and appropriate installation plans and processes
- Development of a maintenance model to support the new systems
- Development of training programs
- Design and implementation of an appropriate In-Service Testing & Compliance process

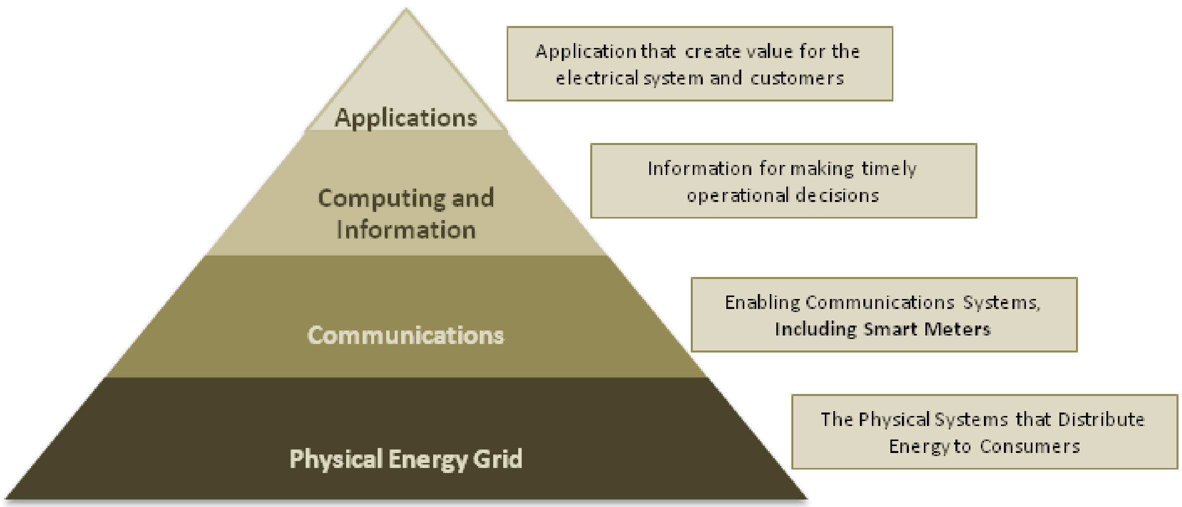
With the significant increase of new measurement technologies and integration of communication systems into basic meters, metering operations will be challenged both technically and operationally in the near and long term. The emphasis on metering operations in utilities will increase as more sophisticated billing and measurement systems are developed, designed and deployed.

3.4 The Smart Grid and Smart Meter Systems

Smart Meter Systems are an integral part of the Smart Grid infrastructure (See figure 2) in data collection and communications. The Smart Grid is essentially the modernization of the transmission and distribution aspects of the electrical grid. Functionally, it is an automated electric power system that monitors and controls grid activities, ensuring the efficient and reliable two-way flow of electricity and information between power plants and consumers—and all points in between. A Smart Grid monitors electricity delivery and tracks power consumption with smart meters that transmit energy usage information to utilities via communication networks. Smart meters also allow the customers to track their own energy use on the

Internet and/or with third-party computer programs. The two-way nature of Smart Meter Systems allows for sending commands to operate grid infrastructure devices, such as distribution switches and reclosers, to provide a more reliable energy delivery system. This is known as Distribution Automation (DA).

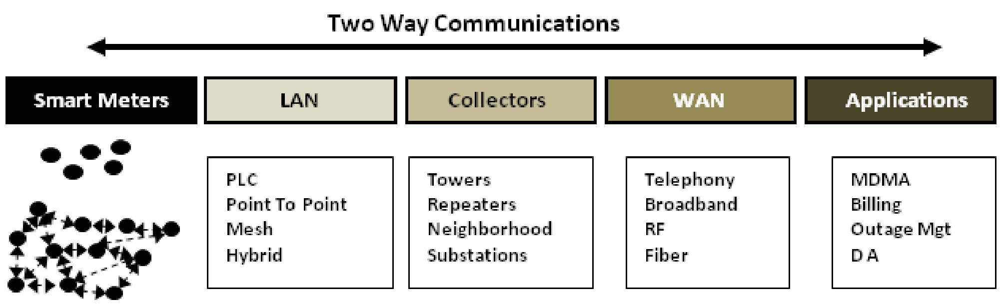
Figure 2: Smart Grid Infrastructure



3.5 Smart Meter Technologies

Smart Meter Systems are varied in technology and design but operate through a simple overall process. The Smart Meters collect data locally and transmit via a Local Area Network (LAN) to a data collector. This transmission can occur as often as 15 minutes or as infrequently as daily according to the use of the data. The collector retrieves the data and may or may not carry out any processing of the data. Data is transmitted via a Wide Area Network (WAN) to the utility central collection point for processing and use by business applications. Since the communications path is two -way, signals or commands can be sent directly to the meters, customer premise or distribution device. Figure 3.0 shows the basic architecture of Smart Meter System operations.

Figure 3: Smart Meter System Basic Architecture



Basic Types of Smart Meter Systems

There are two basic categories of Smart Meter System technologies as defined by their LAN. They are Radio Frequency (RF) and Power Line Carrier (PLC). Each of these technologies has its own advantages and disadvantages in application. The utility selects the best technology to meet its demographic and business needs. Factors that impact the selection of the technology include evaluation of existing infrastructure; impact on legacy equipment, functionality, technical requirements as well has the economic impact to the utility's customers. The selection of the technology requires a thorough evaluation and analysis of existing needs and future requirements into a single comprehensive business case.

Radio Frequency – RF

Smart Meter measurements and other data are transmitted by wireless radio from the meter to a collection point. The data is then delivered by various methods to the utility data systems for processing at a central location. The utility billing, outage management, and other systems use the data for operational purposes. RF technologies are usually two different types:

- **Mesh Technology**
  The smart meters talk to each other (hop) to form a LAN cloud to a collector. The collector transmits the data using various WAN methods to the utility central location.
  - Mesh RF Technologies' advantages include acceptable latency, large bandwidth, and typically operate at 915[7] MHz frequencies.
  - Mesh technologies disadvantages include terrain and distance challenges for rural areas, proprietary communications, and multiple collection points
- **Point to Point Technology**
  The smart meters talk directly to a collector, usually a tower. The tower collector transmits the data using various methods to the utility central location for processing.
  - Point to Point RF technologies advantages include little or no latency, direct communication with each endpoint, large bandwidth for better throughput, some are licensed spectrum, and can cover longer distances.
  - The disadvantages of point to point RF networks are licensing (not for 900MHz), terrain may prove challenging in rural areas (Line of Sight), proprietary communications used for some technologies, and less interface with DA devices.

[7] Generally refers to the FCC's "license free" band of 902-928 MHz

Power Line Carrier - PLC

Smart Meter measurements and other data can be transmitted across the utility power lines from the meter to a collection point, usually in the distribution substation feeding the meter. Some solutions have the collection point located on the secondary side of a distribution transformer. The data is then delivered to the utility data systems for processing at a central location. The utility billing, outage management, and other systems use the data for operational purposes.

- PLC technology advantages include leveraging the use of existing utility infrastructure of poles & wires, improved cost effectiveness for rural lines, more effective in challenging terrain, and the capability to work over long distances.
- PLC disadvantages include longer data transmit time (more latency), less bandwidth and throughput, limited interface with Distribution Automation (DA) devices , and higher cost in urban and suburban locations.

There are other Smart Meter Systems in use that differ from those described above. However, these are generally a hybrid or combination design, a slight variation of the basic types, or niche products. The major Smart Meter System Technologies in use today are of one of these basic types.

4. Deployment of Smart Meter Systems

The deployment of a Smart Meter System begins with selection of the technology and the planning for installing, operating and maintaining it. Utilities have integrated within the deployment process many elements of management, control and compliance to support successful project implementation.

4.1 Selection of Smart Meter Systems

There are several steps in the selection process for Smart Meter Projects. These steps are important to the success of the project and for acceptance by the stakeholders.

Development of Business, Financial and Technical Requirements

The objectives of developing these documents are very important and set the baseline for future decision making and to make sure that due diligence and compliance focus are included in the process. The objectives are:

- To establish among the utility, project team, and vendor a common understanding of the business requirements that must be satisfied by the Smart Meter System.
- To maintain a common set of expectations among all project stakeholders related to the business requirements that must be satisfied by the system and provide a benchmark for the RFP selection process.

Project RFP Bidding Process

After the requirements are developed and approved, the project undergoes a bidding process starting with issuing a Request for Proposal (RFP). The process begins with the formation of a bid team. The team drafts the RFP document, sets time tables, and develops evaluation criteria. The RFP is then sent to qualified Smart Meter system vendors. An initial screening for qualified vendors can be done with assumptions made in the requirements phase. If the RFP is not a turnkey project, a second similar RFP process is used to determine the deployment services vendor.

RFP Evaluation

After the RFP's responses are returned, the bids are evaluated using the criteria determined in the planning. The bids are measured against the business, financial and technical requirements of the utility and then scored. A vendor is selected, approved, and contracts are negotiated. The Smart Meter System Project then transitions to the deployment planning and installation stages.

4.2 Customer Care and Communications

Communications with utility customers concerning the utility's Smart Meter project begins before the deployment of meters begins. These communications should inform the customer about the new Smart Meter System, the benefits, and how it will affect their energy delivery and billing. It is also important to address concerns or issues that may have been raised earlier locally or in other jurisdictions. The communications can be in the form of news releases, mailings or bill stuffers. Customer satisfaction begins with customer communication and education.

Once deployment begins, customers are informed before their meter is changed about the procedures and effects to their specific premise. In addition, the customers are informed face to face at the time of the meter change or a door hanger is left for their information. If the change cannot be made and the customer must be present, a notification on how to make an appointment is left. Mailings, door hangers and call center numbers are intended to help make the process as smooth as possible for individual customers.

4.3 Meter and System Certification and Acceptance

A plan to certify the meters and other system components for purchase and installation is essential to the deployment of the Smart Meter System. The technical requirements developed by the utility will include the Smart Meter equipment specifications for meeting national standards for accuracy, compliance, and functionality criterion.

Smart Meter hardware to be certified must be production units and must conform to or exceed:[8]

- FCC standards for intentional and unintentional radio emissions, and safety related to RF exposure, *parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093*.
- *ANSI C12 .1, 12.10, and 12.20* specifications for meter accuracy and performance
- Local technical codes and requirements
- A functional test designed to verify the compliance to utilities technical and business requirements
- Utility specified requirements that are expected to exceed the standards. Examples:
  - Higher surge requirements for areas with lightning issues
  - Stainless steel enclosures for close seaside locations

The electricity utility industry is continuously developing standards and guidelines to improve the safety, accuracy and operability of meters and associated metering devices. An example of these continuing improvements is the *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability"* under development by AEIC and in conjunction with NIST and Smart Grid Interoperability Panel (SGIP).

Complete performance testing is done by manufacturers and utilities for all meter types and for major design changes to existing meter types, including hardware and firmware. Once the testing is completed successfully, the Smart Meter System components are certified for production and purchase.

After certification and purchasing, the utility establishes a materials acceptance process to evaluate each shipment of equipment for quality and compliance with specification. The acceptance plan is usually a

[8] This list is not exhaustive, and there may be other sets of rules/standards/requirements not reflected but applicable.

combination of vendor manufacturing test data and a sample test plan designed by the utility to meet its risk criteria. In addition to testing items included in the certification phase, other items may be evaluated, such as binding or marrying of the communication module to the meter, accuracy of the face plate data and format, and quality of the meter data received, etc. Completion of this process allows receipt of equipment for field installation.

4.4 Logistics

One of the most important processes in the successful deployment of Smart Meter systems is the logistic and warehousing process. Materials make up 80% of the project capital and management of the processes is a critical success point. The major logistic processes are presented in the table below:

Basic Logistics Processes	Criticality
Smart Meter Ordering	Timely and accurate equipment availability
Smart Meter Shipping, Staging, and Receiving	Sets up the other logistics processes for proper execution
Smart Meter Acceptance Testing	Accept equipment for incoming quality compliance - IQC
Smart Meter Staging for Installation	Proper materials available at the right time for installation
Smart Meter Returns (RMA)	Assessing product issues quickly – disposal of old meters
Data Flows for Materials Tracking	Proper data to set up system head end & customer billing

The proper management and control of the logistics activities improve project cost containment, product availability and management of vendors. The overall process has several handoffs of equipment and data that could be a major source of error in delivery of product, installation of the Smart Meters and network, setting up the system and billing customers. In addition, there are multiple entities involved in the process; including procurement, field installation, metering, materials, customer operations and customer service. It is critical that these groups work together through detailed, planned interactions and that processes are executed smoothly.

The following best practices are representative of procedures that can help the utility use the logistic process to achieve a successful deployment of a Smart Meter Project.

- Single Point of Contact (SPOC) for all invoices from manufacturer and Deployment Services provider
- Tracking of all meter orders from Purchase Order creation to receiving to installation
- Use of tools for tracking every meter removed and installed to a customer premise
- Open lines of communication between the utility, manufacturer and deployment services provider for proactive sharing of information and issue resolution
- A data plan for controlling the quality and accuracy of the data through the logistics process

4.5 Smart Meter Installation

The planning for the installation of Smart Meters is just as important as the actual installation itself. This part of the process, if done correctly, can lead to smooth installation with a minimum of errors, customer issues or installation delays. The safety aspects of the installation conform to:

- The National Electric Safety Code (NESC) for utility wiring
- The National Electric Code (NEC) for home wiring
- ASNI C12.1 – Code for Electricity Metering
- Local building codes

The customer is notified of the installation; if they are present and the installation process begins. The first step in installation involves assessment of access to the meter location and safety of the existing equipment. After proper access has been established, actions include:

- Check meter location for safety issues, damage, and diversion
- Verify meter data for service voltage and meter form type
- Verify premise information for correct address, meter number, GPS Location, etc
- Safely replace old meter with Smart Meter and re-seal
- Update customer premise information for new installation

National demographics show a housing unit split of approximately 74% single family and 26% multi-family homes, with percentages varying from state to state. [9] Therefore, the vast majority of the Smart Meter installations will be to single family homes with single meter base designs. Typically the meter base is mounted to the surface of an exterior wall [10] where the service entrance attaches to the house. Gang meter socket designs are used to consolidate multiple meters to a few locations for the multi-family dwelling units. Generally, these gang sockets are located in designated meter rooms, on the outside wall of apartment buildings, or in the basement of high rise apartment buildings.

Although the single family installations are less complicated than multi-family, the installation processes for both are basically the same. In addition, both processes are designed to address physical access and safety concerns, to make sure the proper type of Smart Meter is installed safely and correctly, and the correct information is obtained and delivered for accurate setup of customer billing.

After the Smart Meter is installed, it is usually ready for operation and is automatically registered with the network system. If the customer is not present and the installation cannot be completed, a notification is left detailing the process to schedule the installation for a later date.

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[9] "*Historical Census of Housing Tables, Units in Structure*"*;* U.S. Census Bureau, Housing and Household Economic Statistics Division; December 16, 2005

[10] See section 6.2 for further discussion

4.6 Data Management

The Smart Meter installation and billing process must be seamless to the customer to maintain customer satisfaction. Even though there is a short interruption of service to the customer premise, this small outage should be acceptable if the customer is properly notified of the installation and their bill is timely and correct. This requires installing the meter at the proper time of the month and maintaining correct management of the data flow during the Smart Meter process and the legacy billing systems.

Planning for proper data interfaces of the Smart Meter System and the utility legacy systems is imperative. At the end of the day, the correct meter, at the correct premise, communicating properly to the utility billing system, with correct premise data will insure an accurate and timely bill generated for the customer. This is the fundamental goal of deployment of a Smart Meter System.

A software system not part of the utilities' traditional metering systems but required to operate a Smart Meter System is a Meter Data Management System (MDMS). MDMS is a major component of Smart Meter deployment and operations, and is the least understood and sometimes forgotten component of the project. This software platform receives meter data from one or multiple Smart Meter technologies, verifies and stores the data, and delivers data subsets to the utility operations applications such as billing, outage management, etc.

An MDMS is installed and operational prior to Smart Meter deployment and is designed to meet the utilities core business needs as well as Smart Meter support. Detailed technical and business requirements, including data storage needs are developed before MDMS application selection. In addition, the data architecture and the IT infrastructure requirements are included in the requirements planning, and cannot be underestimated.

The data system required for supporting Smart Meter deployments is determined by data requirements and number of customers. For small utilities, usually less than 100,000 customers, the Smart Meter head-end can handle the data management needs. For medium and large deployments of Smart Meters, however, the massive data and functional requirements demands a more sophisticated data management system. Interfacing to utility legacy systems is an important step in the successful operation of the system for the utility. The MDMS serves as the interface from the Smart Meter head end to the utility legacy applications to address interface issues and provide the necessary data requirements.

5. Post Deployment Operations and Maintenance

The installation of a Smart Meter System brings on a new set of challenges for the organizations that operate and maintain the utility's legacy processes. Almost all operational processes will change in some fashion once the Smart Meters are installed. This is especially true in the areas of daily interface with the customer by field services and in the maintenance processes for the system. Two important processes significantly affected by the Smart Meter deployment are operational compliance and meter maintenance.

5.1 Operational Compliance

In-Service Testing

The In-Service testing process is an integral part of a utility's due diligence for accuracy of its meters. The two different approaches of in-service testing are periodic and sample methods. The periodic method requires the testing of all meters on a periodic schedule. The sample method requires the yearly sampling of metering groups or strata, usually determined by product manufacturer and purchase date. The in-service sample method is based on sampling techniques specified by ANSI/ASQ Z1.4 or Z1.9. Sample testing is the preferred method for electronic meters because they tend to fail in groups or certain production runs. Sample testing presents a sample of each test group every year and provides indication of issues that may need to be addressed using statistical analysis.

In-service testing has changed over the years as electronic meters have been added to utility service areas. The introduction of a total electronic meter population will require an overhaul of the methodology and redesign of the in-service test plan. However, the revised plan should be appropriate for a total electronic meter population. For example, electronic meter failure modes are different from mechanical meters and should be considered in determining the sampling strata or test groups of the new residential sampling population.

When the Smart Meter System is under deployment, there will be a transition process to take care of new and old meter populations. Since all of the old meters will be removed in a short period of time, some utilities test only the new population of meters deployed using the redesigned test plan. Others may choose to suspend the in-service testing until the project has been completed. Utilities are designing appropriate transition and new steady state plans to meet local regulatory requirements and their business needs.

Periodic On Site Safety Audits and Read Verification

Prior to the Smart Meter System deployment a utility employee would visit the customer premise to read the meter monthly. Generally, utilities leverage this on-site visit to inspect the safety of the electric service, condition of the meter location, access problems, meter anomalies, hot sockets and the general physical condition of the customer site. If possible, issues would be resolved at the time of the visit. The visit was part of a company's due diligence process and became integrated into their asset and risk management procedures.

After deployment is completed, a periodically scheduled site visit to audit the site for safety, meter access and meter reading verification will generally be an element of the operational plan for the Smart Meter project. The plan should begin implementation before deployment is completed. The exact cycle of the site audits will depend upon regulatory requirements, system technology, resources, and business need. Even so, the visual site audit will continue to be an important part of the operational process after Smart Meter deployments ends.

5.2 Meter System Maintenance

Post installation of the meter and communications systems, meter maintenance will become a major change to utility operation. The meter population will be entirely electronic with an additional communications device on board. The challenges associated with supporting the new system will require a new look at existing resources skill sets and the number of available resources left after the project completion. Some of the utility organizations that will share in the new maintenance model are Metering Services, Customer Services, Field Operations, Distribution, IT, and Revenue Protection.

The new model will require the assessment of existing processes and resources, reallocation and organization, shifting of responsibilities, possible supplemental resources, and extensive training. Most utilities have experienced a similar change from the evolution of electronic meters deployed to service commercial and industrial customers in the last fifteen years. The challenge will be handling the magnitude of the changes in process.

6. Smart Meter System Issues

The implementation of Smart Meter Systems has generated some concerns, which the local jurisdictions and serving utilities have addressed or are addressing. Three major issues have been raised and addressed by utilities and the industry. In this regard, utilities have used verification, technical data, and numerous third party investigations to address the customer concerns appropriately.

6.1 Meter Accuracy

As Smart Meter Systems have been deployed nationally, concerns have been raised in different parts of the country concerning the accuracy of these new meters. Although the term Smart Meter is relatively new, the electronic metering technology has been used effectively by utilities for over fifteen years in delivering accurate billing data for at least a portion of their customer base. This new technology was developed with the same due diligence and scrutiny associated with the older mechanical counterparts. All meters, of any technology and design, are required to meet national standards such as ANSI C12 for meter accuracy and operation. Test Equipment used to certify meter performance are traceable to the National Institute of Standards and Technologies (NIST).

Metering professionals have been working with manufacturers over this period to develop the electronic technology referred to today as the Smart Meter. Electronic meters have tighter accuracy tolerances than their mechanical counterparts. Mechanical meters tend to slow down over time due to friction whereas electronic meters have no moving parts. From a technical point of view, Smart Meters were designed to be a more precise and functional measurement device over the life of the product. In addition, the meters are tested for accuracy as part of the manufacturing process and go through acceptance testing by the utility before they are qualified for installation.

Even though Smart Meters as a group are very accurate and precise devices, individual meters can and do sometimes fail. Therefore, utilities have controls in their billing and operational processes to screen for these anomalies and errors can then be corrected before the customer's bill is generated. A large subset of recent complaints came after installation and was perceived to be caused by the changing from an older mechanical meter to a new electronic Smart Meter. In actuality, most changes in meter usage are usually caused by differences produced by load additions, longer billing periods, estimation, new rate structures, or extraordinary weather occurring simultaneously with meter upgrades.[11]

Texas was one of the first areas that had accuracy concerns raised by customer groups. The utilities in this jurisdiction conducted additional tests at the request of the Public Utility Commission of Texas to satisfy customer complaints. This study was conducted by an independent third party not affiliated with any local utility or the regulatory agency. They addressed the meter accuracy and the results of the Smart Meter installation processes. The meter testing consisted of using new Smart Meters and returning Smart Meters installed in the field for testing in a third party testing facility. In addition, some smart meters were tested in

[11] "*Accuracy of Digital Electricity Meters*"; Electric Power Research Institute (EPRI); May 2010

parallel field tests with the old premise meter and the installation process was studied for accuracy. Both types of meter tests confirmed the accuracy of the new Smart Meter devices. The study concluded:[12]

- 99.96 % were within +/- 2% and 99.91% were within +/-0.5%.
- Smart Meters were more stable with tighter accuracy control, and consistently performed better than their mechanical counterparts.
- There was no statistically significant difference in electricity usage that can be attributed to the installation and use of advanced meters.
- The increase in customer complaints correlated with a difference in weather, not with the deployment of Smart Meters.

In summary, the same due diligence and precision have been used to develop Smart Meters as with previous mechanical devices. The accuracy of Smart Meters, both in development and practice, has been proven to improve on the accuracy of the old meter technology. The installation practices were developed to improve and enhance the process of customer billing. All meters, utilizing different technology and designs, are required to meet national standards such as ANSI C12 for meter accuracy and operation before being installed. The development of electronic Smart Meters spanned over fifteen years and produced more stable accuracy, more functionality, and less costly devices for delivery of customer bills.

6.2 Radio Frequency (RF) Exposure

Various Smart Meter Systems work by transmitting information wirelessly. The Federal Communications Commission (FCC) has jurisdiction over the approval and use of radio frequency devices, whether a license is required for the devices or if unlicensed operation is allowed. The FCC has a twofold role in ensuring safety:

- The FCC has allocated the radio spectrum into a variety of sections, most of which needs coordination and a license before operation is permitted. At the same time, the FCC has allocated some frequencies for unlicensed operation (e.g., allowing consumers to purchase products at retail outlets and install them in their homes). These devices operate at low power levels, enabling communications but posing no known health effects to humans. Examples include the WiFi routers already discussed, wireless baby monitors and garage door openers. Most Smart Meters fall under this low power, unlicensed criteria.
- The FCC's second role is to approve radio devices for manufacture, import and sale. Regardless of whether the equipment operates on low power unlicensed channels or at higher power levels that require authorization, each device must be tested to meet FCC standards. The sale of untested and unapproved equipment is a serious offense and the FCC aggressively prosecutes violators. FCC Rules governing the approval and sale of radio devices can be found in the Code of Federal Regulations (CFR) title 47, Part 15. These rules govern all aspects of radio emission, including both intentional and unintentional radiators.

Specific to RF safety issues, the FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute

[12] *"Evaluation of Advanced Meter System Deployment in Texas – Meter Accuracy Assessment"*; Navigant Consulting (PI) LLC; July 30, 2010

of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure (MPE) limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The FCC also presents OET Bulletin 65 to offer suggestions and guidelines for evaluating compliance. The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to RF fields adopted by the FCC.

All Smart Meter radio devices must be certified to the FCC's Rules. Vendors develop products based on technical and regulatory specifications. Often, radio transmitters are integral parts of the meter itself; integrated into the circuit board of the device. The manufacturers test the devices to FCC specifications and then present the test results to an independent certification laboratory, or the FCC directly. Only when the FCC reviews the detailed report and certifies the device can the manufacturer market and sell the devices. The same procedures are used for Wi-Fi network equipment in PCs and wireless routers located nearly everywhere in our homes and offices.

There are two types of potential effects due to RF emissions, non-thermal and thermal. To date, there is no conclusive research that confirms negative non-thermal health impacts caused by non-ionizing RF emissions. There is, however, scientific consensus that for certain RF signal strengths there could be negative health effects. Therefore, most health studies have focused solely on the thermal effects of RF.[13,14] Several studies have been prepared to investigate the RF exposures of Smart Meters with relatively consistent conclusions:

- Smart Meter exposures even at close range and with exaggerated duty cycle are many times less than other household devices and are compliant with FCC limitations.
- As an example, an RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating smart meter would result in Smart Meter RF exposure of 125 to 1250 times less exposure than the cell phone.[15]

Utility installation and operational practices and the impacts of all equipment used in the premise service location affect the exposure levels of RF greatly. Smart Meters are universally mounted in metal enclosures referred to as sockets or bases. These enclosures are generally mounted outside and facing away from the living space of a home. Single family dwellings typically have one socket located at the point of service. For multi-family housing such as apartments, condominiums, and townhouses, the sockets are a single unit with multiple meters. They are usually located in designated meter rooms, on the outside structure wall, or in the basement of high rise apartment buildings. Most of these typical mounting locations are either facing away from or are not adjacent to living areas. In addition, local fire codes and practical construction techniques limit the number of meters that are typically wall mounted, as described above for multi-family

[13] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011

[14] "*Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields";* OET Bulletin 65; Edition 97-01; August; Federal Communications Commission, Office of Engineering & Technology

[15] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

dwellings and are not usually readily accessible. In larger multi-family buildings, i.e. mid-rise and high-rise units, the meters are typically located in meter rooms or in the basements and are ordinarily secured for limited access.

Even in a meter room or basement with large numbers of meters, it is impossible to obtain peak exposure from every meter. For example, if the meter room is 12 feet wide and the body is 2 foot wide, a person could only be within one foot of 17 % of the meters. Typical exposure to Smart Meter fields is usually at some considerable distance. But for those relatively rare instances that result in close proximity to the meters, measurements have shown exposure well below FCC standard limits. Exposure in living spaces will be even less due to the attenuation of RF signal caused by building materials in the walls and other structures. A typical building wall construction combined with a surface mounted meter base will represent a nominal minimum 10 inch (25 cm) distance between the transmitter and the interior wall surface and potential internal dwelling RF exposure to humans. Actual measurements directly behind the meter on the inside of the wall have produced MPE's of 0.01 % of the FCC limits. [16]

At all meter premise locations, the meter socket acts as a barrier for RF emissions entering the home. Manufacturers point out that the area behind the meter socket is virtually a dead spot for RF emissions. In addition, measurements have shown that at 8 inches behind gang meter sockets, the RF exposure is over 10 times less than the same distance in front of the sockets and less than 1% of the FCC exposure limits.[17] The metal meter socket reflects almost all of the RF out of the front of the meter. The only path for RF to get into a building is by first bouncing off the ground or an adjacent house and then back into the building. The distances required for this to happen dramatically reduce the power signal by the time it has traveled a minimum of 4-5 feet to the ground and into the living space.

The following are examples of measured RF exposure level with transmitter at continuous operation (an unrealistic condition) from a gang meter arrangement simulating an apartment metering location.

Example 1

Duty Cycle	% FCC Limit @ 1 ft $\mu W/cm^2$	% FCC Limit @ 2ft	% FCC Limit @ 3 ft	% FCC Limit @ 5 ft
100%	8.1 %	3.9%	2.5%	1.4%

A 10 meter rack with a 250 mWatt 915 MHz Smart Meter transmitter simulating an apartment wall meter installation demonstrating of exposure variance with distance[18]

[16] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010), December 2010

[17] An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010), December 2010

[18] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

Example 2

Duty Cycle	Front Exposure @ 1 ft % FCC MPE	Rear Exposure @ 8 in % FCC MPE	Rear Exposure @ 5 ft % FCC MPE
100%	8.1%	0.6%	0.25%

A 10 meter rack with a 250 mWatt 915 MHz Smart Meter transmitter front and rear measurement RF exposure comparison[19]

The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects. The MPE's are those values of RF field strength, or power density that have been averaged over any 30-minute period (time averaging) and averaged over the dimensions of the body (spatial averaging). Discussed below are several basic factors that affect RF exposure:

RF frequency

Most Smart Meters use the same frequencies as other RF devices in the home, the 915 MHz band and 2.4 GHz band. The RF exposure limits, MPE, set by the FCC for Smart Meters are rated at the frequencies they use to communicate:

- 915 MHz 601 $\mu W/cm^2$ avg.
- 2.4 - 100 GHz[20] 1000 $\mu W/cm^2$

Transmitter Power

Smart Meters use low power transmitters, generally one watt or less for unlicensed frequency, 2 watts licensed, and produce relatively weak RF signals.

Distance

The power density decreases proportional to the square of the distance from the RF source at single meter locations. At multi-meter sites, the power density decreases significantly but at a lesser rate, proportional to the distance.

Duty Cycle (RF Exposure time)[21]

The percentage of time an RF device is in operation is called the duty cycle. The actual percent of time the Smart Meter is transmitting, especially in the initial years of operation, is very small, usually less than 1% (less than15 minutes accumulated total per day). There are several other factors that affect the duty cycle for Smart meter systems.

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19 "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

20 To date there are no known Smart Meter Systems that operate above 6 GHz.

21 "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

The first factor of the duty cycle is how many meters communicate at the same time. As a practical design matter, when several Smart Meters are placed in a cluster, they generally have to communicate with a single controller. In order to ensure that the controller receives the information properly, transmitters are typically programmed to communicate with a controller in a random fashion, significantly decreasing the potential for exposure to multiple signals at the same time.

The second factor is the length of the communication. Smart Meter communications are typically less than a second and under normal operations, the programmed interval for randomized transmissions is 4 to 6 hours or longer. Over time, while it is possible that the duty cycle could rise due to additional use of the system for Smart Grid initiatives, the use of higher data transfer rates could, in fact, diminish the duty cycle.[22] All meters transmitting continuously will disrupt the system from functioning properly due to message traffic congestion and collisions. Therefore, the practical operational limit is less than 50%; well below 100% duty cycle sometimes used for comparisons. In spite of this, several RF exposure studies consider 2% -5% duty cycle operational scenarios, and a 100% duty cycle, continuous operation, scenario to establish an absolute maximum exposure value.

Spatial Averaging

MPE values are measured by averaging the exposure value over the dimensions of the body. Since different parts of a person's body are at varying distances from the transmitter, the RF exposure will vary at different parts of the body. At the typical 5 foot mounting height, a person's head may have maximum exposure but the person's knee will receive less exposure. The spatial average MPE is 18% to 24% of the peak value MPE on the body.[23]

In summary, the RF exposure effects of Smart Meters are very small compared to exposure from other sources in the home. Smart Meters operate significantly below FCC exposure limits. In addition, the location, distance from the transmitter, shielding by meter enclosures, attenuation of building materials and direction of RF emissions even further reduce exposure to consumers. A review of the results of several Smart Meter RF studies and actual measurements of Smart Meter RF emissions support these observations. Other summary observations include:

- All smart meter radio devices must be certified to the FCC's rules.
- Exposure levels drop significantly with the distance from the transmitter, with spatial averaging, and in living spaces due to the attenuation effects of building materials.
- The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects.
- Tests simulating multi-family metering locations containing several meters in close proximity have shown RF exposure levels dramatically less than FCC standards.
- Due to shielding of the meter enclosure and signal patterns, RF exposure from the rear of a metering location is nominally 10 times less than in front of the meter and dramatically below FCC limits, not including the spatial averaging and building material attenuation reductions.[24]

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[22] *"Wireless Transmissions: An Examination of OpenWay Smart Meter Transmissions in a 24 hour Duty Cycle"*; Itron Inc.; 2011; page 6, note #2.

[23] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[24] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

- For measurement and calculation purposes some studies use a 100% duty cycle parameter. However, the maximum operational Duty Cycle for Smart meter systems is less than 50% to prevent message traffic congestion and collisions. The typical Duty Cycles for Smart Meter Systems is between 1% and 5%.
- An RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating Smart Meter would result in Smart Meter RF exposure 125 to 1250 times less than the cell phone.[25]
  - In test environments simulating operational conditions, for power (250 mWatt - 2 Watt), duty cycle (2%-5%) at close distance (1 foot) from the transmitter, Smart Meters cause very low RF exposure to the consumer, typically well under 10 % of the FCC exposure regulations.

6.3 Smart Meter Security

Since the inception of advanced meters with communications capabilities in the last 10-15 years, utilities and vendors have recognized the need for robust security provisions to protect the integrity of data and billing information. As meters evolved with optical ports, RS232/RS485 connections, as well as power line and wireless communications modules concerns have been raised about uncontrolled access to the revenue meters.

With the evolution to AMR and AMI system deployments, the stakes have been raised to protect data and data privacy. These security efforts have extended beyond endpoint security to the collector and head-end system level access control, data validation, and error checking as well as the encryption of data. The use of utility backhaul communications and increase usage of public wireless networks has increased the exposure to potential security intrusions. The proliferation of using the internet and provocative media reports about computer network hacking has raised concerns around the world about the integrity and security of the Smart Grid.

The 9/11 Commission report in 2002 outlined key business continuity expectations and also raised concerns about security of critical infrastructure. Furthermore, the passage by Congress of the Energy Independence and Security Act (EISA 2007) also raised the bar on cyber security of the energy delivery systems and the Smart Grid. Though not directly applicable, NERC CIP requirements for critical infrastructure cyber security at the bulk transmission level has influenced the perspective of cyber security for the entire electrical grid. While specifically intended to address the generation plants, control centers, and major transmission assets/systems, these security concepts have been used as a template to evaluate current Smart Meter systems as well.

With the advent of the EISA 2007 directives that named NIST as the national coordinator for Smart Grid standards, specific efforts has been made to address Smart Grid Cyber Security including Advanced Metering systems. Groups such as the Utility Communications Architecture International User's Group (UCAIug) and their AMI-SEC task force have developed security guidelines, recommendations, and best practices for AMI system elements to lead the industry forward.

In 2009, Congress passed the American Recovery and Reinvestment Act (ARRA or Stimulus Package) which allocated over $3B in federal funding from the Department of Energy (DOE) for Smart Grid Investment Grants (SGIG), including AMI and Smart Grid systems. This placed additional federal scrutiny of the cyber security of systems being specified and deployed. Ultimately, the formation by NIST of the SGIP in 2009 led to the creation of the Smart Grid Interoperability Panel Cyber Security Working Group (CSWG).

[25] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

The culmination of the CSWG efforts was achieved in August 2010 with the release of a comprehensive set of cyber security guidelines as outlined in the publication of the NIST interagency report ***NISTIR 7628 - Guidelines for Smart Grid Cyber Security***. This document recognized the major role that Smart Meters play in the build out of the Smart Grid. The publication of this document has triggered important development and enhancements to Smart Meter systems across the industry. Endpoint and system vendors are being asked to comply with new requirements to address remote access, authentication, encryption, and privacy of metered data and customer information. Third party security certification of smart meter vendors is now being seen across the industry. This will continue to improve and enhance the security and reduce the vulnerability of systems being deployed, including smart meters with integral service switches and load control devices. These cyber security provisions could also extend into Home Area Networks (HAN) as they evolve as well.

Clearly, security and integrity of customer meters has been and continues to be a major concern by utilities and vendors. As the cyber security guidelines continue to evolve, the industry will continue to keep their eye on the ball with regard to data integrity and privacy of customer data.

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A Discussion of Smart Meters And RF Exposure Issues

An EEI-AEIC-UTC White Paper

A Joint Project of the EEI and AEIC Meter Committees

March 2011

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1. Introduction

The following industry discussion of Smart Meters and Radio Frequency (RF) Issues was prepared by the member company representatives from the following organizations.

Edison Electric Institute (EEI)

The Edison Electric Institute (EEI) is the association of U.S. Shareholder-Owned Electric Companies. Our members serve 95 percent of the ultimate customers in the shareholder-owned segment of the industry, and represent approximately 70 percent of the U.S. electric power industry.
Organized in 1933, EEI works closely with all of its members, representing their interests and advocating equitable policies in legislative and regulatory arenas.

The Association of Edison Illuminating Companies (AEIC)

AEIC was founded by Thomas Edison and his associates in 1885. AEIC encourages research and the exchange of technical information through a committee structure, staffed with experts from management of member companies.

AEIC's members are electric utilities, generating companies, transmitting companies, and distributing companies – including investor-owned, federal, state, cooperative and municipal systems – from within and outside the United States. Associate members include organizations responsible for technical research and for promoting, coordinating and ensuring the reliability and efficient operation of the bulk power supply system.

AEIC's Six Technical Committees are: Load Research, Meter and Service, Power Apparatus, Power Delivery, Power Generation and Cable Engineering. AEIC also provides highly valued literature on load research and underground cable specifications and guidelines.

Utilities Telecom Council

The Utilities Telecom Council (UTC) is a global, full-service trade association dedicated to creating a favorable business, regulatory, and technological environment for members. Founded in 1948, UTC has evolved into a dynamic organization that represents the broad communications interests of electric, gas, and water utilities; natural gas pipelines; other critical infrastructure entities and other industry stakeholders. Visit www.utc.org for more information on UTC and its services.

2. Executive Summary

Smart Meters and Smart Meter Systems are being deployed throughout North America, and utilities are continuing their efforts to improve grid reliability and promote energy efficiency while providing improved services to their customers. However, concerns have been raised regarding the potential impacts of radio frequency exposure from these meters on the public. The purpose of this paper is to give an overview of the issues raised recently concerning RF exposure due to the deployment of Smart Meter and Smart Meter Systems. The paper provides a basic overview for understanding how the electric utility industry seeks to ensure the appropriate level of accuracy and safety. It also makes evident that before being accepted and deployed Smart Meters must meet a number of national standards and comply with state and local codes designed to ensure proper operation, functionality and safety.

Radio Frequency (RF) Exposure

Several Smart Meter Systems operate by transmitting information wirelessly. This has raised some concern about the health effects of wireless signals on electric consumers and the general public. Accordingly, this document explains that the RF exposures of Smart Meters are lower compared to other common sources in the home and operate significantly below Federal Communications Commission (FCC) exposure limits.[1] The paper discusses how the location, distance from the transmitter, shielding by meter enclosures, attenuation of building materials, direction of RF emissions, and transmit duty cycle significantly reduce exposure to consumers. It also includes a review of the conclusions of several Smart Meter RF studies and actual measurements of Smart Meter RF emissions to support this conclusion. Other observations include:

- All smart meter radio devices must be certified to the FCC's rules.
- Tests simulating multi-family metering locations containing several meters in close proximity have shown RF exposure levels dramatically less than FCC limits.
- The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects.
- Exposure levels drop significantly (1) with the distance from the transmitter, (2) with spatial averaging, and (3) in living spaces due to the attenuation effects of building materials.
- Due to shielding of the meter enclosure and signal patterns, RF exposure from the rear of a metering location is nominally 10 times less than in front of the meter and dramatically below FCC limits, not including the spatial averaging and building material attenuation reductions.[2]
- For measurement and calculation purposes some studies use a 100% duty cycle parameters. However, the maximum operational Duty Cycle for Smart meter systems is less than 50% to prevent message traffic congestion and collisions. The typical Duty Cycles for Smart Meter Systems is between 1% and 5%.

[1] See Section 5, RF Exposure in Smart Meter Systems

[2] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

- An RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating Smart Meter would result in Smart Meter RF exposure 125 to 1250 times less than the cell phone.[3]
- In test environments simulating operational conditions, for power (250 mWatt - 2 Watt), duty cycle (2%-5%) at close distance (1 foot) from in front of the transmitter, Smart Meters produce very low RF exposure to the consumer, typically well under 10 % of the FCC exposure regulations.

Additionally, before utilities accept and deploy Smart Meters, these devices must meet a number of national standards and comply with state and local codes designed to ensure proper operation, functionality and safety. In particular, Smart Meter and Smart Meter installations are typically designed to conform with and certified to comply with: [4]

- *ANSI C12 .1, 12.10, and 12.20* standards for accuracy and performance
- *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability"*
- FCC standards for intentional and unintentional radio emissions and safety related to RF exposure, *Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]*.
- Local technical codes and requirements
- Utility specific and customer beneficial business and technical requirements

The electric utility industry is continuously developing standards and guidelines to improve the safety, accuracy and operability of meters and associated metering devices. An example of these continuing improvement is *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability"* released in September 2009 to support the needs of developing the Smart Grid.

Finally, the paper discusses how manufacturers conduct complete performance and life cycle testing for all meter types and for major design changes to existing meter types, including hardware and firmware. Once the testing is successfully completed, the Smart Meter System components are utility or third party certified for production and purchase. Furthermore, after certification and purchasing, the paper discusses the utility materials acceptance process to evaluate each shipment of equipment for quality and compliance to specification. Completion of this process by utilities allows for receipt of equipment for field installation.

The deployment of a Smart Meter System begins with selection of the technology and the planning for installation, operation and maintenance. Utilities have integrated within the deployment process many elements of management, control and compliance to support successful project implementation.

[3] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

[4] This list is not exhaustive, and there may be other sets of rules/standards/requirements not reflected but applicable.

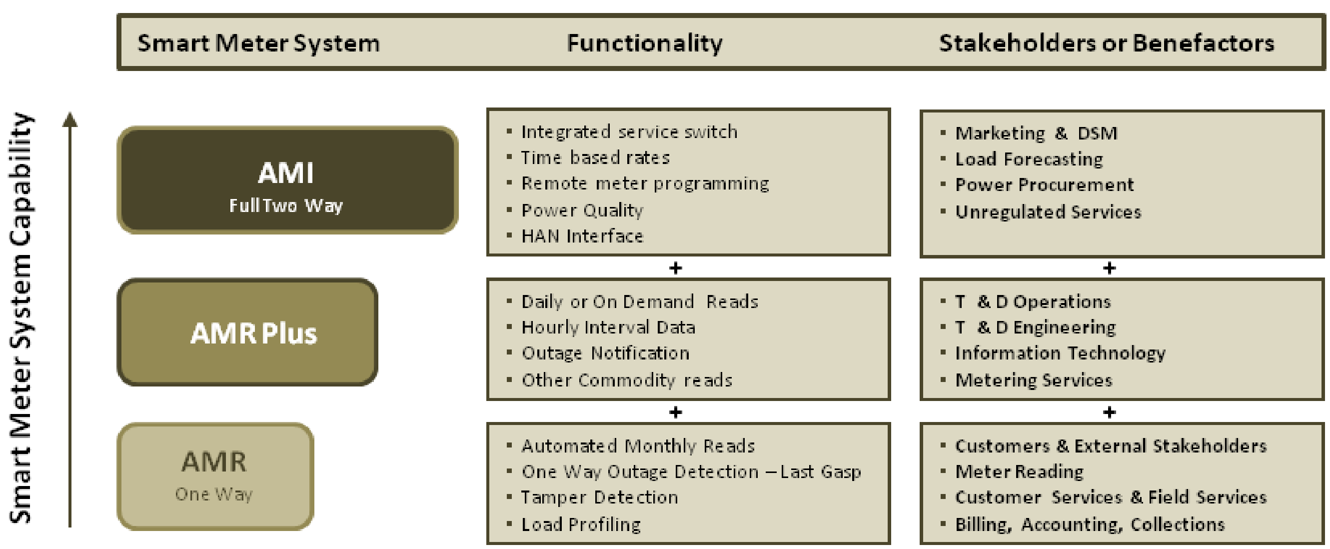
3. An Overview of Smart Meters and Smart Meter Systems

3.1 Definition of Smart Meter and Smart Meter Systems

Smart Meters are electronic measurement devices used by utilities to remotely communicate information for billing customers and operating their electric systems. For over fifteen years electronic meters have been used effectively by utilities in delivering accurate billing data for at least a portion of their customer base. Initially, the use of this technology was applied to commercial and industrial customers due to the need for more sophisticated rates and more granular billing data requirements. The use of electronic meters came into service to the largest customers of the utility and over time gradually expanded to all customer classes. This migration was made possible by decreasing cost of the technology and advanced billing requirements for all customer classes.

The combination of the electronic meters with two-way communications technology for information, monitor and control is commonly referred to as Advanced Metering Infrastructure (AMI). Previous systems which utilized one way communication and were referred to as AMR (Automated Meter Reading) Systems. AMI has developed over time, from its roots as a meter reading substitute (AMR) to today's two-way communication and data system. The evolution from AMR to AMI is shown in Figure 1 with lists of stakeholders and benefactors for each step in the Smart Meter evolution.[5]

Figure 1 – Smart Meter Technology Evolution



[5] Note: All functionality and stakeholder interests are additive, progressing up the chart

Not until the Smart Grid initiatives were established did AMI meters and systems become referred to as "Smart Meters and Smart Meter Systems". Thus, the present state of these technologies should be more appropriately referred to as "an evolution, not a revolution" because of the development and use of Smart Meter technology and communications over the last fifteen years. The combined technologies are also required to meet national standards for accuracy and operability essential in the industry.

Although the Smart Meters are relatively new to the utility industry, they have still been treated with the same due diligence and scrutiny associated with the older electro- mechanical counterparts. These meters have always met or exceeded national standards such as American National Standards Institute (ANSI) C12.1 for meter accuracy and performance. Another quality control is that equipment used to certify meter performance must be traceable to the National Institute of Standards and Technology (NIST), a federal technology agency that works with industry to properly apply technology and measurements.

Other standards in use for the Smart Meter installations include National Electric Code (NEC) for home electrical wiring, National Electrical Manufacturers Association (NEMA) and Underwriters Laboratories (UL) for meters, enclosures and devices, and National Electric Safety Code (NESC) for utility wiring. Through the leadership of utility metering professionals and metering manufacturers, the meticulous and deliberate development of these solid state electronic measurement devices has resulted in meter products that have advanced functionality, are stable and have tighter accuracy tolerances, and are more cost effective for advanced features than the legacy mechanical technologies.

3.2 Smart Meter System Benefits

The benefits of Smart Metering installations are numerous for many different Stakeholders of the systems. The table below lists some of the major benefits for utility stakeholders.

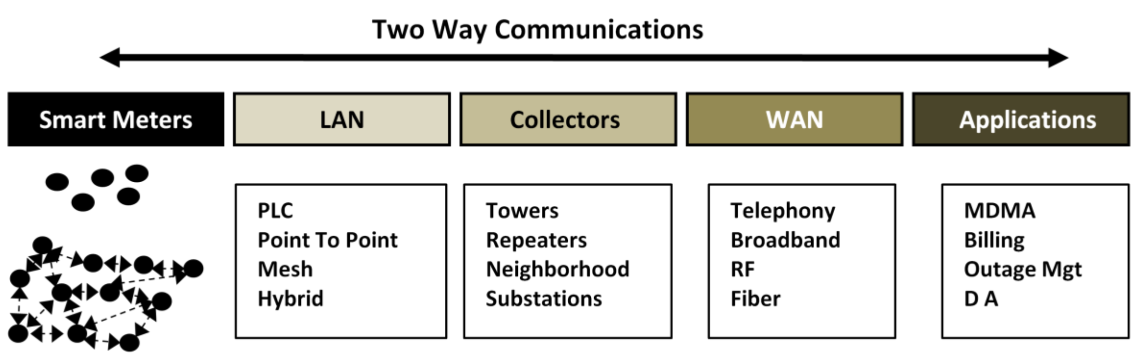
Stakeholder	Benefits
Utility Customers	• Better access and data to manage energy use • More accurate and timely billing • Improved rate options • Improved outage restoration • Power quality data
Customer Service & Field Operations	• Reduced cost of Meter reading • Reduced trips for off-cycle reads • Eliminates handheld meter reading equipment • Reduced call center transactions • Reduced collections and connects/disconnects
Revenue Cycle Services - **Billing, Accounting, Revenue Protection**	• Reduced back office rebilling • Early detection of meter tampering and theft • Reduced estimated billing and billing errors
Transmission and Distribution	• Improved transformer load management • Improved capacitor bank switching • Data for improved efficiency, reliability of service, losses, and loading • Improved data for efficient grid system design • Power quality data for the service areas
Marketing & Load Forecasting	• Reduced costs for collecting load research data

Stakeholder	Benefits
Utility General	• Reduced regulatory complaints • Improved customer premise safety & risk profile • Reduced employee safety incidents
External Stakeholders	• Improved environmental benefits • Support for the Smart Grid initiatives

3.3 Smart Meter Technologies

Smart Meter Systems are varied in technology and design but operate through a simple overall process. The Smart Meters collect data locally and transmit via a Local Area Network (LAN) to a data collector. This transmission can occur as often as 15 minutes or as infrequently as daily according to the use of the data. The collector retrieves the data and may process it or simply pass it on for processing upstream. Data is transmitted via a Wide Area Network (WAN) to the utility central collection point for processing and use by business applications. Since the communications path is two way, signals or commands can be sent directly to the meters, customer premise or distribution device. The utility selects the best technology to meet its demographic and business needs. Figure 3 shows the basic architecture of Smart Meter System operations.

Figure 3: Smart Meter System Basic Architecture



4. Deployment of Smart Meter Systems

4.1 Meter and System Certification & Acceptance

A plan to certify the meters and other system components for purchase and installation is essential to the deployment of the Smart Meter System. The technical requirements developed by the utility will include the Smart Meter equipment specifications for meeting national standards for safety, accuracy, compliance, and functionality criterion.

Smart Meter hardware to be certified must be production units and must conform to or exceed:[6]

- Federal Communications Commission (FCC) standards for intentional and unintentional radio emissions, and safety related to RF exposure*, parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093*.
- *ANSI C12 .1, 12.10, and 12.20* standards for meter accuracy and performance
- Local technical codes and requirements
- A functional test designed to verify the compliance to utilities technical and business requirements
- Utility specified requirements that are expected to exceed the standards. Examples:
  - Higher surge requirements for areas with lightning issues
  - Stainless steel enclosures for close seaside locations

The electric utility industry is continuously developing standards and guidelines to improve the safety, accuracy and functionality of meters and associated metering devices. An example of these continuing improvements is the release of *NEMA SG-AMI 1 "Requirements for Smart Meter Upgradeability" published in September 2009* in conjunction with NIST and Smart Grid Interoperability Panel (SGIP).

Complete performance testing is done by manufacturers and utilities for all meter types and for major design changes to existing meter types, including hardware and firmware. Once the testing is completed successfully, the Smart Meter System components are certified for production and purchase.

After certification and purchasing, the utility establishes a materials acceptance process to evaluate each shipment of equipment for quality and compliance with specification. The acceptance plan is usually a combination of vendor manufacturing test data and a sample test plan designed by the utility to meet its risk criteria. In addition to testing items included in the certification phase, other items may be evaluated. These may include items such as binding of the communication module to the meter, accuracy of the face plate data and data format, and quality of the meter data received, etc. Completion of this process allows receipt of equipment for field installation.

[6] This list is not exhaustive, and there may be other sets of rules/standards/requirements not reflected but applicable.

4.2 Smart Meter Installation

The planning for the installation of Smart Meters is just as important as the actual installation itself. This part of the process, if done correctly, can lead to a smooth installation process with a minimum of errors, customer issues or installation delays. The safety aspects of the installation conform to:

- The National Electric Safety Code (NESC) for utility wiring
- The National Electric Code (NEC) for home wiring
- ASNI C12.1 – Code for Electricity Metering
- Local building codes

The customer is notified of the installation if they are present and the installation process begins. The first step in the installation process involves the assessment of access to the meter location and safety of the existing equipment. After proper access has been established, actions include:

- Check meter location for safety issues, damage, and diversion
- Verify meter data for service voltage and meter form type
- Verify premise information for correct address, meter number, GPS Location, etc
- Safely replace old meter with Smart Meter and re-seal
- Update customer premise information for new installation

National demographics show a housing unit split of approximately 74% single family and 26% multi-family homes, with percentages varying from state to state. [7] Therefore, the vast majority of the Smart Meter installations will be to single family homes with single meter base designs. Typically the meter base is mounted to the surface of an exterior wall [8] where the service entrance attaches to the house. Gang meter socket designs are used to consolidate multiple meters to a few locations for the multi-family dwelling units. Generally, these gang sockets are located in designated meter rooms, on the outside wall of apartment buildings, or in the basement of high rise apartment buildings. Both single family and multi-family installation processes are designed to address physical access and safety concerns, to make sure the proper type of Smart Meter is installed safely and correctly, and to ensure the correct information is obtained and delivered for accurate setup of customer billing.

After the Smart Meter is installed, it is usually ready for operation and is automatically registered with the network system. If the customer is not present and the installation cannot be completed, a notification is left detailing the process to schedule the installation for a later date.

[7] "*Historical Census of Housing Tables, Units in Structure";* U.S. Census Bureau, Housing and Household Economic Statistics Division; December 16, 2005

[8] See section 4 for further discussion

5. RF Exposure in Smart Meter Systems

The implementation of Smart Meter Systems has generated some concerns about RF exposure that the local jurisdictions and serving utilities have addressed or are addressing. In this regard, utilities have used verification, technical data, and numerous third party investigations to address the customer concerns appropriately.

5.1 Radio Frequency (RF) Exposure

Various Smart Meter Systems work by transmitting information wirelessly. The Federal Communications Commission (FCC) has jurisdiction over the approval and use of radio frequency devices, whether a license is required for the devices or if unlicensed operation is allowed. The FCC has a twofold role in ensuring safety:

- The FCC has allocated the radio spectrum into a variety of pieces, most of which needs coordination and a license before operation is permitted. At the same time, the FCC has allocated some frequencies for unlicensed operation (e.g., allowing consumers to purchase products at retail outlets and install them in their homes). These devices operate at low power levels, enabling communications but posing no known health effects to humans. Examples include the WiFi routers already discussed, wireless baby monitors and garage door openers. For the most part, Smart Meters fall under this low power, unlicensed criteria.
- The FCC's second role is to approve radio devices for manufacture, import and sale. Regardless of whether the equipment operates on low power unlicensed channels or at higher power levels that require authorization, each device must be tested to meet FCC standards. The sale of untested and unapproved equipment is a serious offense and the FCC aggressively prosecutes violators. FCC Rules governing the approval and sale of radio devices can be found in the Code of Federal Regulations (CFR) title 47, Part 15. These rules govern all aspects of radio emission, including both intentional and unintentional radiators.

Specific to RF safety issues, the FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure (MPE) limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The FCC also presents OET Bulletin 65 on this topic. The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to RF fields adopted by the FCC. This bulletin offers guidelines and suggestions for evaluating compliance.

All Smart Meter radio devices must be certified to the FCC's Rules. Vendors develop products based on technical and regulatory specifications. Often, radio transmitters are integral parts of the meter itself;

integrated into the circuit board of the device. The manufacturer tests the devices to FCC specifications and then presents the test results to an independent certification laboratory, or the FCC directly. Only when the FCC reviews the detailed report and certifies the device can the manufacturer market and sell the devices. The same procedures are used for Wi-Fi network equipment in PCs and wireless routers located nearly everywhere in our homes and offices.

There are two types of potential effects due to RF emissions, non-thermal and thermal. To date, there is no conclusive research that confirms negative non-thermal health impacts caused by non-ionizing RF emissions. There is, however, scientific consensus that for certain RF signal strengths there could be negative health effects. Therefore, most health studies have focused solely on the thermal effects of RF.[9,10] Several studies have been prepared to investigate the RF exposures of Smart Meters with relatively consistent conclusions:

- Smart Meter exposures even at close range and with exaggerated duty cycle are many times less than other household devices and are compliant with FCC limitations.
- As an example, an RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating smart meter would result in Smart Meter RF exposure of 125 to 1250 times less exposure than the cell phone.[11]

Utility installation and operational practices and the impacts of all equipment used in the premise service location affect the exposure levels of RF greatly. Smart Meters are universally mounted in metal enclosures referred to as sockets or bases. These enclosures are generally mounted outside and facing away from the living space of a home. Single family dwellings typically have one socket located at the point of service. For multi-family housing such as apartments, condominiums, and townhouses, the sockets are a single unit with multiple meters. They are usually located in designated meter rooms, on the outside structure wall, or in the basement of high rise apartment buildings. Most of these typical mounting locations are either facing away from or are not adjacent to living areas. In addition, local fire codes and practical construction techniques limit the number of meters that are typically wall mounted, as described above, for multi-family dwellings and are not usually readily accessible. In larger multi-family buildings, i.e. mid-rise and high-rise units, the meters are typically located in meter rooms or in the basements and are ordinarily secured for limited access.

Even in a meter room or basement with large numbers of meters, it is impossible to obtain peak exposure from every meter. For example, if the meter room is 12 feet wide and the body is 2 foot wide, a person could only be within one foot of 17 % of the meters. Typical exposure to Smart Meter fields is usually at some considerable distance. But for those relatively rare instances that result in close proximity to the meters, measurements have shown exposure well below FCC standard limits. Exposure in living spaces will be even less due to the attenuation of RF signal caused by building materials in the walls and other structures. A typical building wall construction combined with a surface mounted meter base will represent a nominal minimum 10 inch (25 cm) distance between the transmitter and the interior wall surface and

[9] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011

[10] "*Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields";* OET Bulletin 65; Edition 97-01; August; Federal Communications Commission, Office of Engineering & Technology

[11] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

potential internal dwelling RF exposure to humans. Actual measurements directly behind the meter on the inside of the wall have produced MPE's of 0.01 % of the FCC limits. [12]

At all meter premise locations, the meter socket acts as a barrier for RF emissions entering the home. Manufacturers point out that the area behind the meter socket is virtually a dead spot for RF emissions. In addition, measurements have shown that at 8 inches behind gang meter sockets, the RF exposure is over 10 times less than the same distance in front of the sockets and less than 1% of the FCC exposure limits.[13] The metal meter socket reflects almost all of the RF out of the front of the meter. The only path for RF to get into a building is by first bouncing off the ground or an adjacent house and then back into the building. The distances required for this to happen dramatically reduce the power signal by the time it has traveled a minimum of 4-5 feet to the ground and into the living space.

The following are examples of measured RF exposure level with transmitter at continuous operation (an unrealistic condition) from a gang meter arrangement simulating an apartment metering location.

Example 1

Duty Cycle	% FCC Limit @ 1 ft $\mu W/cm^2$	% FCC Limit @ 2ft	% FCC Limit @ 3 ft	% FCC Limit @ 5 ft
100%	8.1 %	3.9%	2.5%	1.4%

A 10 meter rack with a 250 mWatt 915 MHz[13] Smart Meter transmitter simulating an apartment wall meter installation demonstrating of exposure variance with distance[14]

Example 2

Duty Cycle	Front Exposure @ 1 ft % FCC MPE	Rear Exposure @ 8 in % FCC MPE	Rear Exposure @ 5 ft % FCC MPE
100%	8.1%	0.6%	0.25%

A 10 meter rack with a 250 mWatt 915 MHz Smart Meter transmitter front and rear measurement RF exposure comparison[15]

The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects. The MPE's are those values of RF field strength, or power density that have been averaged over any 30-minute period (time averaging) and

[12] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[13] Generally refers to the FCC's "license free" band of 902-928 MHz

[14] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[15] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

averaged over the dimensions of the body (spatial averaging). Discussed below are several basic factors that affect RF exposure:

RF frequency

Most Smart Meters use the same frequencies as other RF devices in the home, the 915 MHz band and 2.4 GHz band. The RF exposure limits, MPE, set by the FCC for Smart Meters are rated at the frequencies they use to communicate:

- 915 MHz 601 $\mu W/cm^2$ avg.
- 2.4 - 100 GHz[16] 1000 $\mu W/cm^2$

Transmitter Power

Smart Meters use low power transmitters, generally one watt or less for unlicensed frequency,
2 watts licensed, and produce relatively weak RF signals.

Distance

The power density decreases proportional to the square of the distance from the RF source at single meter locations. At multi-meter sites, the power density decreases significantly but at a lesser rate, proportional to the distance.

Duty Cycle (RF Exposure time)[17]

The percentage of time an RF device is in operation is called the duty cycle. The actual percent of time the Smart Meter is transmitting, especially in the initial years of operation, is very small, usually less than 1% (less than 15 minutes accumulated total per day). There are several other factors that affect the duty cycle for Smart meter systems.

The first factor of the duty cycle is how many meters communicate at the same time. As a practical design matter, when several Smart Meters are placed in a cluster, they generally have to communicate with a single controller. In order to ensure that the controller receives the information properly, transmitters are typically programmed to communicate with a controller in a random fashion, significantly decreasing the potential for exposure to multiple signals at the same time.

The second factor is the length of the communication. Smart Meter communications are typically less than a second and under normal operations, the programmed interval for randomized transmissions is 4 to 6 hours or longer. Over time, while it is possible that the duty cycle could rise due to additional use of the system for Smart Grid initiatives, the use of higher data transfer rates could, in fact, diminish the duty cycle.[18] All meters transmitting continuously will disrupt the system from functioning properly due to message traffic congestion and collisions. Therefore, the practical operational limit is less than 50%; well below 100% duty cycle sometimes used for comparisons. In spite of this, several RF exposure studies consider 2% -5% duty

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16 To date there are no known Smart Meter Systems that operate above 6 GHz.

17 "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

18 *"Wireless Transmissions: An Examination of OpenWay Smart Meter Transmissions in a 24 hour Duty Cycle*"; Itron Inc.; 2011; page 6, note #2.

cycle operational scenarios, and a 100% duty cycle, continuous operation, scenario to establish an absolute maximum exposure value.

Spatial Averaging

MPE values are measured by averaging the exposure value over the dimensions of the body. Since different parts of a person's body are at varying distances from the transmitter, the RF exposure will vary at different parts of the body. At the typical 5 foot mounting height, a person's head may have maximum exposure but the person's knee will receive less exposure. The spatial average MPE is 18% to 24% of the peak value MPE on the body.[19]

In summary, the RF exposure effects of Smart Meters are very small compared to exposure from other sources in the home. Smart Meters operate significantly below FCC exposure limits. In addition, the location, distance from the transmitter, shielding by meter enclosures, attenuation of building materials, direction of RF emissions, and limited duty cycles even further reduce exposure to consumers. A review of the results of several Smart Meter RF studies and actual measurements of Smart Meter RF emissions support these observations. Other summary observations include:

- All smart meter radio devices must be certified to the FCC's rules.
- Exposure levels drop significantly with the distance from the transmitter, with spatial averaging, and in living spaces due to the attenuation effects of building materials.
- The FCC limits on maximum permissible exposure (MPE) for application to the general public were set using safety factors fifty times lower than the levels of known effects.
- Tests simulating multi-family metering locations containing several meters in close proximity have shown RF exposure levels dramatically less than FCC standards.
- Due to shielding of the meter enclosure and signal patterns, RF exposure from the rear of a metering location is nominally 10 times less than in front of the meter and dramatically below FCC limits, not including the spatial averaging and building material attenuation reductions.[20]
- For measurement and calculation purposes some studies use a 100% duty cycle parameter. However, the maximum operational Duty Cycle for Smart meter systems is less than 50% due to message traffic congestion and collisions. The typical Duty Cycles for Smart Meter Systems is between 1% and 5%.
- An RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating Smart Meter would result in Smart Meter RF exposure 125 to 1250 times less than the cell phone.[21]
- In test environments simulating operational conditions, for power (250 mWatt - 2 Watt), duty cycle (2%-5%) at close distance (1 foot) from the transmitter, Smart Meters cause very low RF exposure to the consumer, typically well under 10 % of the FCC exposure regulations.

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[19] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[20] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI (2010),December 2010

[21] "*Health Impacts of Radio Frequency (RF) from Smart Meters*"; California Council on Science and Technology (CCST); January 2011; page 20

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EEI A Smart Grid. A Powerful Future.

Key Issues in Perspective:

SMART METERS and YOUR HEALTH

The electric power industry is modernizing the nation's electric grid. Using advanced technologies, electric companies are building a smart grid that will deliver more reliable power to customers across the country and allow two-way communication between customers and their electric companies.

Installing smart meters is an important step in building the smart grid. Smart meters currently are being installed in homes and businesses across the country. Typically located on the outside of a building or house, smart meters enable customers to track their power usage and to learn more about the way they use electricity. This empowers customers to manage their electricity usage and use energy wisely.

Smart grid technology also allows electric companies to detect power outages more precisely and to restore power more quickly. In fact, some outages actually may be avoided by giving electric companies more options to reduce demand when the system is under stress. The meters also provide more accurate load data to electric companies, enabling them to plan and operate the electric grid more efficiently.

As with any new technology, customers have questions about how a smart meter works and what impact it may have on their lives. We've developed a series of frequently asked questions (FAQs) and answers to address key topics. The following FAQs discuss smart meter technology and your health. Some smart meters use technologies that transmit radio frequencies (RF) to provide communication between electric companies and their customers. While concerns have been raised about the potential impact of the RF generated by these smart meters, numerous studies have shown that smart meters using RF technologies pose no health risk. For additional information, please visit SmartGrid.eei.org.

What is RF?

According to the Federal Communications Commission (FCC), "Radio waves and microwaves … are one form of electromagnetic energy. They are collectively referred to as 'radiofrequency' or 'RF' energy."[1] Radio waves are used for telecommunications services; however, many common electric devices—including baby monitors and microwave ovens—also use radio waves.

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[1] Federal Communications Commission Web site, Office of Engineering and Technology, "Radio Frequency Safety," http://transition.fcc.gov/oet/rfsafety/rf-faqs.html.

How does a smart meter work?

A smart meter is a digital upgrade to the decades-old mechanical meter found in homes and businesses across the country. A smart meter with RF technology uses a low-power radio to communicate the electricity usage of a home or business to the electric company through remote communication technologies. This means that your electric company no longer will need to send someone to read your meter on a regular monthly basis. Most homes already have electric devices that use RF signals, such as cell phones, microwaves, laptop computers, and televisions.

Is the RF generated by smart meters hazardous to your health?

No.

As with any electric device that utilizes RF, smart meters have been monitored, tested and certified to ensure they meet certain safety standards. The RF exposure levels from smart meters are far below the levels permitted by the FCC, which sets health standards for RF exposure, based on extensive reviews of the biological and health literature. The FCC limits on maximum permissible exposure to the general public created safety factors that are 50 times higher than the levels of known effects. The U.S. standards for radio waves are similar to those of the European Union and Canada.

According to the Electric Power Research Institute, the "relatively weak" strength of the RF signals generated by smart meters means that any impact of RF exposure would be minimal—similar to the levels of the exposure from televisions and radios.[2] In fact, smart meters produce significantly less RF exposure than other common electric devices, such as cell phones, baby monitors, wireless routers, laptop computers, and microwave ovens.

What's more, RF exposure depends partly on the proximity of the RF source to a person. Smart meters are usually located on the outside of your house in a metal box, away from your daily routine activity. Due to the extremely brief exposure to the radio waves that smart meters produce, there have been no long-term health effects identified as a result of the installation of smart meters, according to a study conducted by the California Council on Science and Technology.[3]

How does RF exposure from a smart meter compare to other electric devices?

RF exposure from a smart meter is far below—and more infrequent—than other common electric devices. In fact, smart meters typically broadcast their signal for less than a minute at a time and usually less than a total of 15 minutes each day. The communication is usually from outside the customer's home, so exposure to radio waves is minimal. In addition, the electric panel and wall behind the meter actually block much of the radio signal from entering the home.

RF is measured in units of microwatts per square centimeter. A microwatt is very small—it's one-millionth of a watt.

- Held at your ear, a cell phone's RF signal would be 1,000 to 5,000 microwatts per square centimeter.

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2 "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter," Electric Power Research Institute, December 2010.

3 "Health Impacts of Radio Frequency Exposure from Smart Meters," California Council on Science and Technology, March 31, 2011.

- Standing two feet from a microwave oven, the RF signal would be 50 to 200 microwatts per square centimeter.

- Standing 10 feet from a smart meter, the RF signal would be 4 microwatts per square centimeter.

Experts calculate that it would take 30 years of living with a smart meter to receive the same RF exposure that a typical cell phone user receives in just one day.

Is the RF exposure of smart meters regulated?

Yes.

The FCC sets the standards for RF exposure and is responsible for approving the technology that smart meters use. All smart meter radio devices must be certified in compliance with the FCC's rules and guidelines before being installed. The manufacturer tests the devices to FCC specifications and then presents the test results to an independent certification laboratory or to the FCC directly. Only after the FCC reviews the detailed report and certifies the smart meter radio device can the manufacturer market and sell the devices. The same procedures are used for Wi-Fi network equipment in personal computers and wireless routers located nearly everywhere in our homes and offices.[4]

[4] "A Discussion of Smart Meters and RF Exposure Issues: An EEI-AEIC-UTC White Paper," Edison Electric Institute; Association of Edison Illuminating Companies; and Utilities Telecom Council, February 2011.

The Edison Electric Institute (EEI) is the association of U.S. shareholder-owned electric companies. Our members serve 95% of the ultimate customers in the shareholder-owned segment of the industry, and represent approximately 70% of the U.S. electric power industry. We also have as Affiliate members more than 80 International electric companies, and as Associate members more than 200 industry suppliers and related organizations.

Organized in 1933, EEI works closely with all of its members, representing their interests and advocating equitable policies in legislative and regulatory arenas.

EEI provides public policy leadership, critical industry data, strategic business intelligence, one-of-a-kind conferences and forums, and top-notch products and services.

For more information on EEI programs and activities, products and services, or membership, visit our Web site at www.eei.org.

Edison Electric Institute
701 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2696
202-508-5000
www.eei.org

EEI A Smart Grid. A Powerful Future.

Key Issues in Perspective:

SMART METERS and DATA PRIVACY

The electric power industry is modernizing the nation's electric grid. Using advanced technologies, electric companies are building a smart grid that will deliver more reliable power to customers across the country and allow two-way communication between customers and their electric companies.

Installing smart meters is an important step in building the smart grid. These advanced meters enable customers to track their power usage and learn more about the way they use electricity. This will help customers better manage their electricity usage in the future.

Smart meter technology also allows electric companies to detect power outages more precisely and to restore power more quickly. In fact, some outage actually may be avoided by giving electric companies more options to reduce demand when the system is under stress. The meters also provide data to electric companies, enabling them to operate the electric grid more efficiently.

As with any new technology, customers have questions about how a smart meter works and what impact it may have on their lives. We've developed a series of frequently asked questions (FAQs) and answers to address key topics. The following FAQs discuss the privacy and security of the electricity usage data collected and transmitted by smart meters. As the smart grid allows electric companies to collect real-time customer usage data, customers want to ensure that their data are secure. America's electric companies work hard to protect the privacy of their customers' data—and continue to make data privacy a key priority as the smart grid develops. For more information about the smart grid, visit SmartGrid.eei.org.

What is a smart meter?

A smart meter is a digital upgrade to the decades-old mechanical meter found in homes and businesses across the country. A smart meter uses advanced technology to communicate the electricity usage of your home or business to your electric company through remote communication technologies. This means that your electric company no longer will need to send someone to read your meter on a regular monthly basis.

The meter's digital technology also enables two-way communication between you and your electric company. This two-way communication allows your electric company to identify and respond more quickly to potential problems, like power outages. Your electric company also may have the ability to communicate current electricity prices to you—empowering you to better manage your electric bills.

Smart meters look similar to traditional mechanical meters, but the digital technology inside the meter makes them more efficient. Electric companies currently are installing smart meters in homes across the country.

How often do smart meters transmit data to my electric company?

That depends on the specific technology powering your meter and the data requirements of your electric company. However, most smart meters send usage data to your electric company one to four times a day. Some systems are programmed to send data as often as every 15 minutes.

How do I know my electricity usage data remain private and secure?

America's electric companies work hard to protect the privacy of their customers' data—and have always done so. As the smart grid allows electric companies to collect customer usage data on a more frequent basis, electric companies will be able to use this information to provide more personalized customer service. Electric companies also use customer data to help with their operational and business planning.

Electric companies are making the security and privacy of customer data a key component of the grid modernization effort. Companies use advanced encryption technologies to protect all data transmitted by smart meters. Electric companies also comply with the data privacy guidelines and regulations set by state public utility commissions.

Since protecting customer data is a top priority in modernizing the grid, electric companies are working with federal agencies, such as the Department of Homeland Security, the Department of Energy, and the National Institute of Standards and Technology (NIST), to adapt existing privacy and security standards to meet the new data requirements that accompany smart grid technology. NIST guidelines are being applied to remote access, authentication, encryption, and the privacy of metered data and customer information.

How do state regulators help to ensure that my data are secure?

Electric companies are highly regulated at the state level. Before an electric company can implement a smart meter program, it must submit to its state regulatory commission detailed plans that describe how the data security systems will protect customer data. State regulators closely monitor the privacy safeguards that are being developed for the new smart grid technology systems.

What steps are being taken to protect my smart meter from cyber security threats?

Cyber security threats can cause disruptions in the flow of power and other problems if cyber intruders send computer signals to the electronic controls used in some electric generation and transmission infrastructure. The electric power industry takes cyber security threats very seriously. In fact, electric companies must meet mandatory cyber security standards that require companies to implement training, physical security, and asset recovery plans to protect against the threat of cyber attacks.

As the smart grid is built, electric companies are incorporating cyber security protections into both the grid architecture and the new smart grid technologies. The electric power industry is working closely with vendors, manufacturers, and government agencies to ensure that the smart grid is secure. These measures also help to ensure that customer data remains protected from cyber security threats.

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As with any new technology, customers have questions about how a smart meter works and what impact it may have on their lives. We've developed a series of frequently asked questions (FAQs) and answers to address key topics. The following FAQs discuss the accuracy of the electricity usage data collected and transmitted by smart meters. As the smart grid allows electric companies to collect real-time customer usage data, customers want to ensure that their data are accurate. In fact, advanced technologies help to ensure that the usage data collected by electric companies are more accurate than ever. For more information about the smart grid, visit SmartGrid.eei.org.

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A smart meter is a digital upgrade to the decades-old mechanical meter found in homes and businesses across the country. A smart meter uses advanced technology to communicate the electricity usage of your home or business to your electric company through remote communication technologies. This means that your electric company will no longer need to send someone to read your meter on a regular monthly basis.

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That depends on the specific technology powering your meter and the data requirements of your electric company. However, most smart meters send usage data to your electric company one to four times a day. Some systems are programmed to send data as often as every 15 minutes.

How do I know that the electricity usage data being sent to my electric company are accurate?

The technology systems that support smart meter systems have extensive data validation processes to protect the accuracy of your billing records. In addition, smart meters must meet rigorous requirements for accuracy, which were developed by the American National Standards Institute (ANSI). National Institute of Standards and Technology (NIST)-certified test equipment also is required to verify initial and continuing smart meter accuracy.

A recent study by an independent testing group found that 99.91 percent of smart meters were accurate within 0.5 percent.[1] In fact, the study found that smart meters were more accurate than the mechanical meters they replaced. In addition, smart meter groups are continuously tested and monitored by your electric company to ensure they are operating correctly.

Electric companies constantly monitor the data transmitted from smart meters to verify that electricity usage is within expected ranges. If readings show a significant difference from normal levels of use, technicians will inspect the meter. Your electric company takes these steps to ensure that your electric bill is accurate.

How does my electric company ensure that my neighbor's data won't be confused with mine?

A digital signature helps match the electricity usage data according to your address and the specific smart meter installed on your home or business. As data are transmitted from your smart meter to the electric company, this digital signature is validated multiple times.

[1] Edison Electric Institute, "Smart Meters and Smart Meter Systems: A Metering Industry Perspective," March 2011.

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