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Memorandum
From the office of
Commissioner Brenda Burns
Arizona Corporation Commission
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PHOENIX, ARIZONA
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TO: Docket Control
DATE: Monday, July 07, 2014
FROM: Office of Commissioner Brenda Burns
SUBJECT: Docket No. E-00000C-11-0328

ORIGINAL

Attached is the APS response to technical questions from the Sedona Smart Meter Awareness group. Please be aware this has also been docketed under docket #E-01345A-13-0069.

Arizona Corporation Commission

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BARBARA D. LOCKWOOD
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PO Box 53999
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June 20, 2014

Commissioner Brenda Burns
Arizona Corporation Commission
1200 West Washington
Phoenix, AZ 85007

RE: Response to Sedona Smart Meter Awareness Group Questions

Dear Commissioner Burns:

Enclosed please find Arizona Public Service Company's (APS) responses to the informal questions you forwarded to us on behalf of the Sedona Smart Meter Awareness Group. APS has attempted in good faith to respond to these voluminous, highly technical and often vague questions, making what the Company believes to be reasonable assumptions when necessary but assumptions that may not be shared by the authors of the questions. And given the nature of the questions asked, APS would like to reserve the ability to supplement or amend these responses at the appropriate time and if further information becomes available.

Please feel free to contact me if you have any questions. Thank you.

Sincerely,

A handwritten signature in cursive script that reads "Barbara Lockwood".

Barbara Lockwood
General Manager

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 1: How many Smart Meters, repeaters, routers, and collectors, will be installed in Sedona? What other elements of the mesh grid network will be installed - gateway, cell antennas, distributed antenna system (DAS).

Response: For purposes of the Company's response to questions contained in this set of questions, APS is using the following definitions:

Node Meter: An advanced digital meter which employs two-way communications technology through a mesh network to capture residential and/or business energy usage data and perform critical operational functions (for example, customer rate changes and disconnect/re-connect requests). These Node Meters also receive data from and transmit data to nearby Node Meters through the mesh network (see definition below). These meters are often referred to as "smart meters" or "repeater meters."

Repeater/Router: A device that only receives and transmits (routes) data between Node Meters and/or Gatekeeper Meters. These devices are not able to read energy usage data and are typically located on utility distribution poles or street light poles. Repeaters/routers have not been installed in the Sedona area.

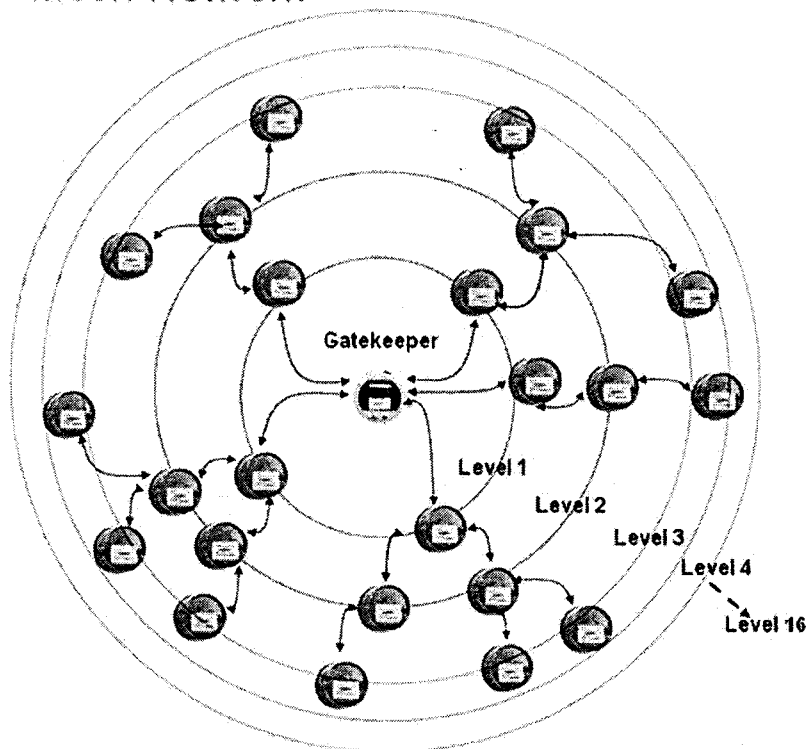
Gatekeeper Meter: An advanced digital meter employing two-way communications technology that collects data from Node Meters within a mesh network using Local Area Network (LAN) technology then transmits that data, upon request, to the Company's central information system using Wide Area Network (WAN) cellular technology. These meters can also capture residential and/or business energy usage data and perform critical operational functions (for example, customer rate changes and disconnect/re-connect requests).

Mesh Network: A communications network in which each interconnected device gathers and relays data to each other using wireless technology. APS's advanced metering infrastructure utilizes a Mesh Network to gather energy usage data and perform critical operational functions. The following diagram provides an illustration of a Mesh Network.

SEDONA SMART METER AWARENESS QUESTIONS TO ARIZONA PUBLIC SERVICE COMPANY

Response to Question 1 continued:

Mesh Network



Currently, the APS Mesh Network is capable of building out to 16 levels if necessary, although a typical configuration utilizes four levels.

APS has installed approximately 9,300 Node Meters and 22 Gatekeeper Meters in the greater Sedona area. APS has not utilized Repeaters/Routers or Distributed Antenna Systems (DAS) in Sedona.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 2: In what locations within Sedona will the infrastructure items be installed?

Response: All APS AMI infrastructure facilities have been installed in easements and public rights-of-way in accordance with the Company's franchise agreement with the City of Sedona.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 3: What are the frequency ranges that each piece of equipment emits and uses in its operation, including actual and projected when fully operational with appliances.

Response: Please refer to the definitions provided in response to Question #1.

Node Meters and the non-cellular technology in Gatekeeper Meters operate in the 900 MHz range. The frequency range of the cellular technology in Gatekeeper Meters is determined by the cellular network employed, and is typically either in the 850 MHz range or the 1900 MHz range.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 4: What would be the power output from Smart Meters for Zigbee transmissions?

Response: The power output of a Zigbee module is 100 mW (+20 dBm).

Zigbee modules are not currently installed in APS's AMI meters with the exception of approximately 100 meters in the metro Phoenix area where residential customers have voluntarily agreed to participate in the Company's Commission-approved Home Energy Information pilot program.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 5: What is the transmission range or geographical coverage for each of the above mentioned equipment - smart meter, repeaters, routers, collectors, antennas, etc.?

Response: Transmission ranges for Node Meters and Gatekeeper Meters are dependent on several factors, including height of the transmitting and receiving devices, orientation of the meters, and the surrounding environment (obstacles, etc.). For Node Meters deployed by APS, an average, entirely unobstructed range for point-to-point communications is approximately 2500 feet in an urban environment and approximately 5800 feet in a rural environment.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 6: What is the coefficient attenuation which is a cumulative figure which combines all (not some or one) radiation emissions of all devices inside a grid system?

Response: An "attenuation coefficient" is the mathematical measurement of the opacity of a particular substance (the ability of a substance to block radiation such as light or radio waves). A "mass attenuation coefficient" is the mathematical measurement of the cumulative opacity of substances within a specified environment. For example, an attenuation coefficient can be calculated for water, while a mass attenuation coefficient can be calculated for a glass of water (because the mass attenuation coefficient includes the calculation for the water and the glass combined).

By definition, therefore, an attenuation coefficient cannot be calculated for radiation emissions themselves.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 7: What are the cumulative radiation emissions that affect the house from everything hit by the EMF between the routers, antennas and meter bases holding the Smart Meters? That includes any biologic or material effects of any kind.

Response: APS is not aware of any studies that calculate cumulative light, radio, or other radiation effects on a particular building. Moreover, because each building will be subject to different radiation effects due to size, location, time of day, and other factors, and because each building will have a different attenuation coefficient depending upon the materials it was built with and upon, no two buildings will have the same attenuation coefficient.

All devices used by APS to measure customer usage must be certified by the FCC to meet Maximum Permissible Exposure (MPE) limitations as specified in FCC Regulation 47 CFR 1.1310. This regulation can be found at:

<http://www.gpo.gov/fdsys/granule/CFR-2010-title47-vol1/CFR-2010-title47-vol1-sec1-1310>

APS's AMI meter vendor has certified that all devices employed by APS meet these regulations.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 8: Do the frequencies from the Smart Meters, routers, and antennas penetrate buildings or stop at the meter base?

Response: The ability of radio frequency to penetrate a building is entirely dependent upon the attenuation coefficient of the type of material of which a particular building or a particular meter base is composed.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 9: Can the frequencies be reflected from the iron containing rock formations?

Response: The ability of rock formations of any type to reflect radio frequency energy is entirely dependent upon the attenuation coefficient (or mass attenuation coefficient) of a particular rock formation.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 10: What is an average duration (in seconds) that a residential smart meter transmits in a 24 hour period? How is this average computed or measured?

Response: The overall daily duration of transmissions for a Node Meter is determined by three separate functions: the meter data collection schedule, the number of surrounding Node Meters transmitting data to the Node Meter, and the number of unscheduled transmissions performed.

The data collection schedule is programmed into the Node Meters by the meter manufacturer and does not change. The following table provides the transmission times that have been programmed into the Node Meters used by APS:

	Approximate Transmission time per day (in seconds) ¹
Meter reads used for billing	2
Hourly usage data	2
Voltage data	2
Meter scans/optimizations	1
Time stamps	10
TOTAL (in seconds)	17

¹These transmission times have been rounded up to the nearest whole number to account for an estimate of the unscheduled transmission times discussed below.

The number of surrounding Node Meters transmitting data to any individual Node Meter varies according to the needs of the mesh network. The duration of transmissions for this function is dependent upon the number of Node Meters transmitting data, and the transmission time increases with the number of transmitting meters.

Unscheduled transmissions occur for several types of events such as service control messages (connects, disconnects, demand/kW resets, etc.), power outage and restoration messages, meter tampering messages, unscheduled on-demand electric usage reads, voltage threshold messages, and software upgrades. As these transmissions are performed on an as-needed basis, daily transmission times for these functions are variable and can only be estimated.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 11: What is an average duration (in seconds) that a commercial smart meter transmits in a 24 hour period? How is this average computed or measured?

Response: Residential Node Meters and commercial Node Meters perform the same basic functions; the transmission times for commercial meters will be the same as provided in Question No. 10.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 12: How many times in total (average and maximum) is a smart meter scheduled to transmit during a 24-hour period?

Response: The daily transmission schedule is programmed into the Node Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

The Node Meter daily transmission schedule is provided below:

	Number of Transmissions
Meter reads used for billing	6x/day (every 4 hours)
Hourly usage data	8x/day (every 3 hours)
Voltage data	8x/day (every 3 hours)
Meter scans/optimizations	4x/day (every 6 hours)
Time stamps	96x/day (every 15 minutes)

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 13: How many times in total (average and maximum) is a collector meter scheduled to transmit during a 24-hour period?

Response: The mesh network daily transmission schedule is programmed into the Gatekeeper Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

The Gatekeeper daily transmission schedule is provided below:

	Network Utilized	Number of Transmissions
Meter reads used for billing	Mesh	6x/day (every 4 hours); Received from Node meters
Hourly usage data	Mesh	8x/day (every 3 hours); Received from Node meters
Voltage data	Mesh	8x/day (every 3 hours); Received from node meters
Meter scans/optimizations	Mesh	4x/day (every 6 hours)
Time stamps	Mesh	96x/day (every 15 minutes)
Hourly usage data/Voltage data	Cellular	1x/day; Transmitted to APS
Meter reads used for billing	Cellular	1x/day; Transmitted to APS
Meter optimizations	Cellular	1x/day; Transmitted from APS

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 14: How many times in total (average and maximum) is a repeater meter scheduled to transmit during a 24-hour period?

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 10.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 15: How many of those times (average and maximum) are to transmit electric usage information?

Response: APS assumes this question refers to Node Meters (see the definitions provided in the Company's response to Question No. 1).

The daily transmission schedule is programmed into the Node Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

Please refer to the Company's response to Question No. 12. Node Meter transmissions are categorized below:

	Type of Transmissions
Meter reads used for billing	Electric usage
Hourly usage data	Electric usage
Voltage data	Power Quality
Meter scans/optimizations	Meter maintenance
Time stamps	Meter maintenance

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 16: For a collector meter, how many of those times (average and maximum) are to transmit electric usage information?

Response: The daily transmission schedule is programmed into the Gatekeeper Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

Please refer to the Company's response to Question No. 13. Gatekeeper transmissions are categorized below:

	Type of Transmission
Meter reads used for billing	Electric usage
Hourly usage data	Electric usage
Voltage data	Power quality
Meter scans/optimizations	Meter maintenance
Time stamps	Meter maintenance

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 17: For a repeater meter, how many of those times (average and maximum) are to transmit electric usage information?

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 15.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 18: How many of those times (average and maximum) are for other purposes? What are those other purposes? Please specify number of times (average and maximum) by type/category of transmission.

Response: APS assumes this question refers to Node Meters (see the definitions provided in the Company's response to Question No. 1).

The daily transmission schedule is programmed into the Node Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

Please see the Company's response to Question No. 15.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 19: For a collector meter, how many of those times (average and maximum) are for other purposes? What are those other purposes? Please specify number of times (average and maximum) by type/category of transmission.

Response: The daily transmission schedule is programmed into the Gatekeeper Meters by the manufacturer and does not change. Therefore, there is no "average" or "maximum" schedule.

Please refer to the Company's response to Question No. 16.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 20: For a repeat meter, how many of those times (average and maximum) are for other purposes? What are those other purposes? Please specify number of times (average and maximum) by type/category of transmission.

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 15.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 21: Under what scenarios does a Smart Meter transmit outside of the daily schedule, i.e., unscheduled transmissions such as an on-demand read, a tamper/theft alert, utility shut off, firmware upgrade etc.?

Response: Please see the Company's response to Question No. 10.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 22: Under what scenarios does a collector meter transmit outside of the daily schedule, i.e., unscheduled transmission such as on-demand read, tamper/theft alert, utility shut off, firmware upgrade etc.?

Response: The same types of unscheduled transmissions that may occur for Node Meters may also occur for Gatekeeper Meters. Please see the Company's response to Question No. 10.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 23: Under what scenarios does a repeater meter transmit outside of the daily schedule, i.e., unscheduled transmission such as on-demand read, tamper/theft alert, utility shut off, firmware upgrade etc.?

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 10.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 24: Typically, how much of the communication between the customer's meter and the utility is unscheduled vs. scheduled? How is unscheduled determined and why?

Response: The unscheduled transmissions discussed in the Company's responses to Question No. 10 are only performed on an as-needed basis. APS has not attempted to determine the amount of scheduled transmissions versus unscheduled transmissions. For an individual customer, unscheduled transmissions would typically occur significantly less often than scheduled transmissions. For example, an unscheduled transmission would occur whenever a customer turns on or shuts off power or experiences an outage.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 25: Are there any other factors that go into determining duration and/or frequency of meter transmissions (e.g., if a meter can't access the network when it's trying to send data, type of a meter etc.)? If yes, please identify these factors.

Response: Meter transmissions may increase if a Node Meter cannot transmit the electric usage data it has stored at the meter's regularly scheduled transmission time due to meter malfunctions, obstacles, or other reasons. The Gatekeeper Meter will periodically re-query these meters to attempt to receive data until the transmission is successful. Additionally, any meter that cannot connect to the mesh network will send time request messages every 2.5 minutes (rather than the scheduled 15 minute transmissions) until a network connection is established.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 26: For a Smart Meter, what is the amount of RF emissions the FCC designated at the source (at a distance of 20 centimeters from the meter) when a meter is transmitting data (instantaneous maximum peak level, averaged over 30 minutes)? What is the Transmission Power in mW? What is the Antenna Gain in Decibel Isotropic? What is the Instantaneous Peak Level (Effective Isotropic Radiated Power)?

Response: Devices must be certified by the FCC to meet Maximum Possible Exposure (MPE) requirements as specified in FCC Regulation CFR 1.1310. The limits specified by the FCC are based on frequency and the values are averaged over a 6-minute time period. The power density limit for the 900 MHz band is 0.6 mW/cm^2 . The FCC validates a device using a calculation distance of 20 centimeters. In the MPE report for the Node Meters in use at APS, the transmit power was measured to be 232 mW, the maximum antenna gain is 3.66 (5.63 dBi) and the distance is 20 centimeters. This results in a calculated power density of 0.169 mW/cm^2 which is 0.431 mW/cm^2 below the limit. These calculations assumed the device was transmitting 100% of the time during the 6-minute averaging period, which is not a valid assumption for these devices.

These raw power density calculations do not take into account how often a device is transmitting. A typical electricity meter has an overall transmit duty cycle (scheduled and unscheduled transmissions) of less than 1% (it transmits less than one percent of the time). The average power density would therefore be 1/100 of the maximum calculated power density, resulting in an exposure value of 0.28% of the FCC limit.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 27: For a collector meter, what is the amount of RF emissions the FCC designated at the source (at a distance of 20 centimeters from the meter) when a collector meter is transmitting data (instantaneous maximum peak level, averaged over 30 minutes)? What is the Transmission Power in mW? What is the Antenna Gain in Decibel Isotropic? What is the Instantaneous Peak Level (Effective Isotropic Radiated Power)?

Response: Please see the Company's response to Question No. 26.

In the MPE report from the FCC for the LAN technology within the Gatekeeper Meters APS uses (please refer to the definitions provided in the Company's response to Question No. 1), the transmit power was measured to be 204 mW, the maximum antenna gain is 3.27 (5.15 dBi) and the distance is 20 centimeters. This results in a calculated power density of 0.133 mW/cm², which is 0.467 mW/cm² below the FCC limit. These calculations assumed the device was transmitting 100% of the time during the 6-minute averaging period, which is not a valid operational assumption for these meters.

The MPE report from the FCC for the WAN technology within the Gatekeeper meters APS uses measured the following at a distance of 20 centimeters averaged over a 6-minute time period:

Transmit Power - 250 mW
Maximum Antenna Gain - 3 dBi

Using these measurements, the calculated power density of the WAN technology in the Gatekeeper meters is 0.259 mW/cm², which is 0.341 mW/cm² below the FCC limit. These calculations assumed the meter was transmitting 100% of the time during the 6-minute averaging period, which is not a valid operational assumption for these meters.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 28: For a repeater meter, what is the amount of RF emission the FCC designated at the source (at a distance of 20 centimeters from the meter) when a repeater meter is transmitting data (instantaneous maximum peak level, averaged over 30 minutes)? What is the Transmission Power in mW? What is the Antenna Gain in Decibel Isotropic? What is the Instantaneous Peak Level (Effective Isotropic Radiated Power)?

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 26.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 29: For a Smart Meter, does the amount of RF emission vary depending on duration of transmission/volume of data being sent? For example, are RF emissions higher when there is a larger volume of data to be transmitted?

Response: Radio frequency energy does not vary in amplitude based on the amount of information transmitted or on the duration of the transmission.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 30: For a collector meter, does the amount of RF emission vary depending on duration of transmission/volume of data being sent? For example, are RF emissions higher when there is a larger volume of data to be transmitted?

Response: Radio frequency energy emitted from a Gatekeeper Meter does not vary in amplitude based on the amount of information transmitted or on the duration of the transmission.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 31: For a repeater meter, does the amount of RF emission vary depending on duration of transmission/volume of data being sent? For example, are RF emissions higher when there is a larger volume of data to be transmitted?

Response: Please see the definitions provided in the Company's response to Question No. 1.

This information is provided in the Company's response to Question No. 29.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 32: Are there any other factors that impact the amount of RF emissions? If so, please identify the factor(s) and its impact on RF emissions.

Response: The amount of radio frequency energy emitted from Node Meters and Gatekeeper Meters, when operational, does not vary in amplitude for any reason at the point of emission.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 33: Are there RF or other emissions when the meter is not transmitting?
If yes, what type and what amounts of emission are there?

Response: Both Node Meters and Gatekeeper Meters contain a microprocessor and, as is the case with all electronic appliances and devices with microprocessors, emit minute radio frequency energy whenever they are powered on.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 34: Are any analog meters which have transmitters installed or to be installed in Sedona?

Response: No.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 35: Are ratepayers paying for the added costs of all these transmissions from Smart Meters, collectors, routers, repeaters?

Response: The Company's rates are determined by the Arizona Corporation Commission during rate cases in which APS's expenses are thoroughly reviewed by Commission Staff and intervening parties. Expenses include those costs related to the Company's overall metering infrastructure for operation and maintenance, property taxes, depreciation, income taxes, and a return on investment. No costs are assigned to individual meter transmissions.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 36: Have Smart Meters been tested and shown to comply with FCC and FDA public safety limits (limits for uncontrolled public access)?

Response: The FCC has certified all APS AMI meters as compliant with the maximum permissible exposure requirements specified in FCC Regulation 47 CFR 1.1310.

The FCC provides information about how these requirements were established and the relationship between the FCC and FDA at this website:

<http://transition.fcc.gov/oet/rfsafety/rf-faqs.html>

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 37: What demonstration is there is there that wireless smart meters will comply with existing FCC limits, as opposed to under strictly controlled conditions within government testing laboratories?

Response: Please see the Company's response to Question No. 36.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 38: Has the FCC been able to certify that compliance is achievable under real-life use conditions including, but not limited to:

- a. In the case where there are both water and electric meters on the home located closely together.
- b. In the case where there is a bank of electric and gas meters, on a multi-family residential building such as on a condominium or apartment building wall. There are instances of up to 20 or more meters located in close proximity to occupied living space in the home, in the classroom or other occupied public space.
- c. In the case where there is a collector meter on a home that serves the home plus another 500 to 5000 other residential units in the area, vastly increasing the frequency of RF bursts. Is the homeowner notified that they have a repeater or collector meter?
- d. In the case where there is one smart meter on the home but it acts as a relay for other local neighborhood meters. What about 'piggybacking' of other neighbors' meters through yours? How can piggybacking be reasonably estimated and added onto the above estimates?
- e. What about the RF emissions from the power transmitters? Power transmitters installed on appliances (perhaps 10-15 of them per home) and each one is a radiofrequency radiation transmitter.
- f. How can the FCC certify a system that has an unknown number of such transmitters per home, with no information on where they are placed?
Where people with medical/metal implants are present? (Americans with Disabilities Act protects rights)

Response: AMI meters used by APS are in compliance with FCC regulations.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 39: What assessment has been done to determine what pre-existing conditions of RF exposure are already present? On what basis can compliance for the family inside the residence be assured, when there is no verification of what other RF sources exist on private property?

Response: APS has not done such an assessment. APS AMI meters comply with FCC requirements for public exposure limits, which is the only established standard for radio frequency energy emissions.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 40: How is the problem of cumulative RF exposure properly assessed (wireless routers, wireless laptops, cell phones, PDAs, DECT or other active-base cordless phone systems, home security systems, baby monitors, contribution of AM, FM, television, nearby cell towers, etc).

Response: Please see the Company's response to Question No. 39.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 41: What is the cumulative RF emissions worst-case profile? Is this estimate in compliance with FCC and FDA?

Response: Please see the Company's response to Question No. 39.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 42: What study has been done for people with metal implants* who require protection under the Americans with Disabilities Act (ADA)? What is known about how metal implants can intensify RF, heat tissue and result in adverse effects below RF levels allowed for the general public? What is known about electromagnetic interference (EMI) from spurious RF sources in the environment (RFID scanners, cell towers, security gates, wireless security systems, wireless communication devices and routers, wireless smart meters, etc.)

Response: APS is not aware of any such study.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 43: Do the Smart Meters collect data such as 'Load Signatures'? If you say they do NOT, how can we be sure that they don't? Is there any documentation? If not, can an independent 'lab' be allowed to perform a test to determine if the load signatures are collected or not. (link to document:

<http://www.dora.statc.co.us/puc/docketsdecisions/DocketFilings/091-593EG/091-593EG Spring2009 Report-SmartGridPrivacy.pdf>

Response: For purposes of this response, the Company defines a "Load Signature" as the unique waveform of an electrical device when it is in use.

APS's AMI meters do not have the ability to monitor load signatures or waveforms of individual electric devices.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 44: What is the maximum theoretical power output of the WAN transmitter used in the smart meters? WAN stands for a wide area network.

Response: For the purpose of the Company's responses to Questions No. 44 through No. 49, the following definitions are used:

WAN: The Wide-Area Network utilized by APS for wireless transmissions between the third-party cellular provider's transmission equipment (cell towers) and the Company's Gatekeeper Meters.

LAN: The Local-Area Network utilized by APS for wireless transmissions between Node Meters and surrounding Node Meters and between Node Meters and Gatekeeper Meters.

The maximum output power of the WAN transmitters in the Company's Gatekeeper Meters is 0.25 watts.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 45: What is the licensed maximum power output of the WAN transmitter used in the smart meters?

Response: The licensed maximum output power of the WAN transmitters in the Company's Gatekeeper Meters is 0.25 watts.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 46: Do the deployed smart meters include both a WAN transmitter and a HAN transmitter? HAN stands for home area network (where an oven or other appliance is linked via RF to the smart meter). If yes, are the HAN transmitters on by default?

Response: The only APS AMI meters with Home-Area Network (HAN) modules installed are approximately 100 meters in the metro Phoenix area where residential customers have voluntarily agreed to participate in the Company's Commission-approved Home Energy Information pilot program (see the Company's response to Question No. 4).

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 47: What is the current duty cycle (i.e., how long is the smart meter emitting radiation every 24 hours) range for the WAN transmitters of deployed smart meters? Is this figure expected to increase over time? If so, to what levels?

Response: The duty cycle of a Gatekeeper Meter is based on software controlled schedules and is typically well below 10%. APS currently has no plans to change these schedules.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 48: What is the frequency range for the WAN transmitters used in the smart meters?

Response: The frequency range of the WAN technology in Gatekeeper Meters is determined by the cellular network employed, and is typically either in the 850 MHz range or the 1900 MHz range.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 49: Is the WAN transmitter used on the smart meters omnidirectional (i.e., shoots in all directions) or directional (i.e., shoots principally in one direction). If directional, about how wide is the cone of radiation at 3,10 and 20 feet? If directional, is there a way for a consumer to tell which direction the meter WAN transmitter is pointing and thus try to stay out of the beam?

Response: The WAN transmitter antenna in the Gatekeeper Meter is omnidirectional.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 50: Are the deployed smart meters arranged in mesh networks? If yes, what is the duty cycle range for those meters configured as repeater and collection nodes (i.e., a smart meter that acts a collector of radiation from many surrounding smart meters and a more frequent transmitter of radiation to a neighborhood receiver)?

Response: Yes, the Company's AMI infrastructure is arranged in a Mesh Network (please refer to the definitions provided in the Company's response to Question No. 1). Please see the response to Question No. 47 for the duty cycle for Gatekeeper Meters.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 51: Are there any outward markings that identify a smart meter as a collection node smart meter and that would enable a consumer to know that he has a collection node smart meter. Have those consumers who have been or are slated to be burdened with a collection node meter been informed by the electric providers (or anyone else) that their smart meter is operating as a collection node? If not, will they be? If these repeater meter and collection node meters are installed in a commercial area, will the rate payer be informed that their meter is operating as a repeater and collection node?

Response: APS declines to answer this question based on concerns for the privacy and security of its infrastructure and customers.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 52: Is it possible for a hacker to gain access to a smart meter or mesh network? If not, have that been tested and proven?

Response: It is possible that a skilled hacker intimately familiar with the proprietary architecture of the meters or the mesh network could gain access to the network. However, APS is committed to the security of its meters and mesh network and has implemented measures to protect both from unauthorized access. The measures taken have been reviewed both internally and by third-party cybersecurity experts.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 53: If the answer to 51 is YES, then can a hacker do any of the following:

- a. Increase the duty cycle of the meter WAN transmitter to 100% (i.e., set it so that it emits microwave radiation constantly)?
- b. shut off the consumer's power?
- c. Cause the smart meter to overheat (by manipulating the meter's voltage regulator or by other means)?

Response: APS assumes this question is related to the answer to Question No. 52 rather than Question No. 51.

- a. A skilled hacker familiar with the proprietary architecture could potentially increase the duty cycle of an AMI meter.
- b. Physical access to any type of meter (AMI or analog) will allow the power to be shut off.
- c. No.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 54: Do clusters of smart meters, such as those present on apartment buildings and other group living environments, commercial offices, etc. emit greater levels of microwave radiation than single-family unit smart meters?

Response: All meters are individually the same. The mesh system employed at APS is primarily a request/response system and, as such, it is uncommon for co-located meters to transmit at the same time. Even for common events such as power outages, meters will randomize their transmissions, making it unlikely that multiple meters are transmitting simultaneously.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 55: Do smart meters arranged in clusters, such as those present on apartment buildings, and other group living environments, commercial offices, etc. ever emit microwaves that constructively interfere (like two ocean waves colliding and producing a much bigger wave), and by superposition produce radiation beams of greater intensity? Have any of the sources of information relied upon by the electric providers as allegedly establishing the safety of smart meters considered clustered meter radiation? If so then please identify.

Response: Please see the Company's answer to Question No. 54.

All AMI meters used by APS meet FCC radio frequency energy emissions limits.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 56: What is the relevance of the FCC standards for microwave radiation thermal effects (specific absorption rate, etc.) to the risks of chronic diseases, such as cancer, miscarriage, birth defects, semen quality, autoimmune diseases, etc. from chronic (24/7), localized microwave radiation (i.e., from smart meters)? Did the FCC study the effects of chronic, localized microwave radiation on the human body before issuing that standard in 1996?

Response: The FCC standard is the only recognized standard in the United States.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 57: Have any of the sources of information relied upon by the electric providers as allegedly establishing the safety of smart meters considered the non-thermal effects on the human body of chronic, low level microwave radiation from smart meters? If so then please identify.

Response: APS complies with the FCC standard.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 58: It took decades for the scientific community to work out some of the mechanisms linking tobacco to cancer formation and Agent Orange to cancer formation. During those decades the relevant industries (tobacco, the Pentagon) argued tobacco and Agent Orange did not cause disease. Given the denial of scientific study on the non-thermal effects of microwave radiation from smart meters, is it possible that, as in the cases of tobacco and Agent Orange, evidence of disease will take time to manifest itself?

Response: Please see the Company's response to Question No. 56.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 59: The International Agency for Research on Cancer, a branch of the World Health Organization, in year 2011 deemed radio-frequency radiation, which is emitted by cell phones, smart meters and many other devices, a "possible carcinogen." Do the electric providers consider this finding wrong? If so, on what basis? Why does APS still state on their "Radio Frequency" literature "The World Health Organization has concluded that no known adverse health effects can be attributed to low-level radio frequency"?

Response: Please see the Company's response to Question No. 56.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 60: Why is APS not waiting until the results of the AZ Dept of Health Services Study before continuing the deployment of Smart Meters?

Response: Given that customers may decline installation of AMI meters, APS decided to proceed with completing deployment.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 61: What methods are employed to avoid effects of "dirty electricity" related to SMPS, including but not limited to, electromagnetic interference, biological effects, RF filtering, and/or shielding and power factor corrections? If no such methods are employed, describe in complete detail all methods that APS is aware of to avoid or control dirty electricity and explain why they have not been employed.

Response: Node Meter circuit boards are designed to minimize emissions. Where needed, bypass capacitors are added to further minimize emissions. Inductive and capacitive components can also be deployed specifically to reduce the emissions conducted back into power lines if necessary. The AMI meters used by APS are certified to comply with applicable FCC regulations.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 62: What methods are employed to avoid the effects of over-voltage or over-current, from smart meters?

Response: APS's AMI meters meet ANSI C12.1-2001, ANSI C12.20-2002, California PUC D.98-12-080, CISPR22, and ANSI C12.1-2007 (Draft 8) certifications which encompass over-voltage and over-current requirements.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 63: In APS' literature, Myth vs. Fact, it states that "Automated meters are safe." What independent studies have you based this "fact" on?

Response: Please see the Company's response to Question No. 56.

Many studies have shown that radio frequency energy is safe. Please see studies filed by APS in the Arizona Corporation Commission's Investigation into Smart Meters in Docket No. E-00000C-11-0328.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 64: For those rate payers who use 1,000 kilowatt hours or less each month, live in a dwelling that is 1,100 sq. ft or less and have no swimming pool or spa that is electrically heated, the standard flat rate plan makes the most sense. This plan does not require a smart meter nor can they take advantage of any savings that require a smart meter. Why is this information not disclosed to ratepayers?

Response: APS disagrees with the premise of this question. Information related to benefits available to customers with AMI meters is available on aps.com.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 65: Does APS that Smart Meters emit EMF? Who are the health experts APS used to assess the safety and health effects of EMF?

Response: Yes. Please see the Company's response to Questions No. 39 and 72.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 66: How does APS explain the illnesses reported to the ACC after Smart Meters were installed? What investigations into health did APS do following those reports? When was the first report (s) filed? Why did this not trigger an assessment of health issues? Has anyone ever been sick from an analog meter?

- Response:**
- a. APS's AMI meters are compliant with FCC regulations for public exposure limits, therefore APS has no explanation for the illnesses described above.
 - b. Please see the presentation given by APS's expert epidemiologist in the Commission's Docket No. E-00000C-11-0328. Additionally, please see the Company's response to Question No. 72.
 - c. See response to b. above.
 - d. The Commission has commissioned a health assessment. See response to b. above.
 - e. APS is unaware of any claims of illness due to analog meters.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 67: Why does the APS information sheet on RF talk about FCC guidelines when there are none for non-ionizing radiation?

Response: All radio frequency energy emitted by the meters employed by APS falls into the non-ionizing radiation spectrum. The FCC sets requirements for these frequencies in FCC regulation 47 CFR 1.1310.

SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY

Question 68: APS says WHO did not find adverse health effects of RF in 2010.
What about the 2011 report that declared RF a class 2B carcinogen?
How does knowing that affect APS decisions?

Response: Please see the Company's response to Question No. 56.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 69: Why did APS not consider a wired option?

Response: The Company evaluated all available technologies and their ability to meet the Company's business and service needs when determining the type of metering system to employ at APS. APS selected AMI technology as the appropriate system to most effectively and efficiently serve customers in its service territory.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 70: California's PG&E employees wear electro-protective clothing when installing Smart Meters. Do APS employees wear electro- protective clothing?

Response: All APS employees that work directly with any electric facilities are required to wear Personal Protective Equipment (PPE) clothing. The clothing increases the safety of the employee from the inherent hazards of high voltage and current when working with the electricity that passes through the meter. APS employees installing meters do not wear any protective clothing related to anything other than electrical contact.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 71: Is APS aware that the FDA website has an 8-page Position Paper on EMF Interferences on Medical Devices and directly on the human body?

- (a) What studies are actually planned on people for safety - including pregnant women, children, those with compromised health of brain and heart?
- (b) The FDA will likely not accept a literature review/meta analysis in lieu of actual biological safety testing on meters under various conditions.
- (c) The FDA normally puts the full safety responsibility on equipment manufacturers, with end users (APS) having responsibility for assuring the proper tests were done and proven safe in all populations. Has APS done this?

Response: Please see the Company's response to Question No. 39.

**SEDONA SMART METER AWARENESS QUESTIONS TO
ARIZONA PUBLIC SERVICE COMPANY**

Question 72: Concerning APS and the safety of Smart Meters please give us your answers to the following 10 Questions:

1. Is microwave energy safe?
2. How many studies have proven it safe?
3. Bibliography of those studies?
4. What have been the duration of those studies?
5. What has been the exposure, distance, intensity, time?
6. Have they been human, animal, studies or model studies?
7. Are the studies based on thermal heating or actual biological tissues, animals, or people?
8. What health effects have been studied?
9. Where were the studies conducted?
10. Who funded the studies?

Response:

1. APS's AMI meters comply with FCC standards..
2. Many studies have shown that radio frequency energy is safe. Please see studies filed by APS in the Arizona Corporation Commission's Investigation into Smart Meters in Docket No. E-00000C-11-0328.
3. Please see the response to part 2 of this question.
4. Please see the response to part 2 of this question.
5. Please see the response to part 2 of this question.
6. Please see the response to part 2 of this question.
7. Please see the response to part 2 of this question.
8. Please see the response to part 2 of this question.
9. Please see the response to part 2 of this question.
10. Please see the response to part 2 of this question.