

# RADIO READ WATER METER SYSTEM

## HEALTH EFFECTS

Nearly 120 million radio frequency devices have been installed in the past five years in North America to gather usage data from water, gas and electric meters. Utilities of all sizes and types have realized the operational and customer service benefits of automating their data collection processes. But as the use of these systems has grown, some have raised question over public safety. Have the health effects of these devices been adequately considered? In this article, we'll try to address the issue of these health effects, and try to distinguish fact from fiction in the process.

### BACKGROUND

First, we need to provide some background on the physics of radio frequency (RF) systems. For the purposes of brevity, we'll only hit the high points in this article, but we've added more information on our website at [www.neptunetg.com](http://www.neptunetg.com).

Radio frequencies are part of a broad range of energy phenomena called the "electromagnetic spectrum". Everything in the electromagnetic spectrum consists of waves of energy that are measured in terms of their frequency and magnitude. The electromagnetic spectrum includes not only radio waves but also visible light.

Frequencies are measured in Hertz and 1 Hertz=1 cycle per second. We use metric prefixes, kilo, mega, giga, and so on to designate multiples of 1 thousand, 1 million, and 1 billion Hertz respectively. So a device operating at 900 MHz, which is commonly called used for RF devices in many automatic meter reading systems, is oscillating at 900,000,000 (or  $9 \times 10^8$ ) times per second.

The human voice typically has a frequency range of 85 to 255 Hz. The electromagnetic spectrum is often subdivided into two categories: ionizing radiation and non ionizing radiation. The human voice would be non-ionizing.

The EPA provide the following definitions:

*Radiation that has enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to remove electrons, is referred to as "non-ionizing radiation." Examples of this kind of radiation are sound waves, visible light, and microwaves.*

*Radiation that falls within the "ionizing radiation" range has enough energy to remove tightly bound electrons from atoms, thus creating ions. This is the type of radiation that people usually think of as "radiation." We take advantage of its properties to generate electric power, to kill cancer cells, and in many manufacturing processes.*

Automatic meter reading (AMR) and advanced metering

infrastructure (AMI) systems typically operate in the 450MHz to 2.4GHz frequency range. And there are many other devices we use every day that operate using radio frequencies including baby monitors, remote car keys, smart phones, cellular networks, cordless telephones, AM & FM radio broadcasts, garage door openers, radio controlled toys, television broadcasts, satellite communications, police radios, and the list goes on and on.

With the explosion in social media, smart phones WiFi, mobile streaming, GPS systems, and a myriad of other applications, the use of RF has grown exponentially. As of June 2011, the number of connected devices with wireless subscriptions was 322.8 million, which exceeds the estimated U.S. population. Unless you live in a specially designed shielded room like an anechoic chamber, you're exposed to RF signals 24/7.

### HEALTH EFFECTS

So, what is the impact of RF-based AMR and AMI systems on our health?

We'll use the terms previously identified to start the discussion. We are all aware that some levels of ionizing radiation as found in Gamma Rays, X-Rays, and certain types of ultraviolet light are harmful to our health. RF systems that are used for AMR and AMI systems fall into the category of non-ionizing radiation, as they do not have sufficient energy to change the structure of molecules with which they come in contact.

Within the non-ionizing group of frequencies, where do AMR and AMI equipped smart meters fall? The table below shows the relative power density in microwatts per square centimeter so that the various devices can be compared. Although water devices were not specifically measured in this independent study, they would tend to operate like gas smart meters which are also dependent on battery power and therefore can't transmit as often or at an output power as high as electric smart meters.

As we can see, the level of exposure to RF emissions is much less for smart meters (gas and water being the lowest of these) than our typical exposure to laptops, WiFi networks, and cell phones.

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While there are many published opinions on the topic, the following summary from Health Canada seems to be one of the most concise.

*As with any wireless device some of the RF energy emitted by smart meters will be absorbed by anyone who is nearby. The amount of energy absorbed depends largely on how close your body is to a smart meter. Unlike cellular phones, where the transmitter is held close to the head and much of the RF energy that is absorbed is localized to one specific area. RF energy from smart meters is typically transmitted at a much greater distance from the human body. This results in very low RF exposure levels across the entire body, much like exposure to AM or FM radio broadcast signals. Survey results have shown that smart meters transmit data in short bursts, and when not transmitting data, the smart meter does not emit RF energy. Furthermore, indoor and outdoor survey measurements of RF energy from smart meters during transmission bursts were found to be far below the human exposure limits specified in Health Canada's Safety Code .*

Based on this information, Health Canada concluded that exposure to RF energy from smart meters does not pose a public health risk.

So there does not appear to be a link between RF emissions in AMR and AMI systems and concerns about public health.

<b>Comparison of RF Power Density in the Everyday Environment</b> (microwatts per square centimeter)	
Adjacent to a gas Smart Meter ( 1 foot)	0.00166
Adjacent to an electric Smart Meter (10 feet)	0.1
Adjacent to an electric Smart Meter (1 foot)	8.8
Microwave oven nearby (1 meter)	10
Wireless routers, laptop computers, cyber cafes. Etc. maximum (~1 meter for laptops, 2-5 meters for access points)	10 to 20
Cell phone at head	30 to 10,000
Walkie Talkie (at head)	500 to 42,000

### Personal Experience

And beyond the studies, we at Neptune have some rather unique personal experience to add to the discussion. Located at our factory and headquarters in Tallassee, Alabama, Neptune has it's "meter farm" which is used for testing meters and RF devices in various environmental conditions. At any give time, there are some 1,300 operational radios located about 100 fee from our engineering office. In addition, every day thousands of new radios are manufactures, activated and tested on-site. This is a level of RF saturation that would be very uncommon even in the densest urban settings.

We ran two twenty-minute tests at our office to determine the power density in the area of our engineering office (where we work every day). It should be noted that in addition to the signals from the radios manufactured and tested on site, there are several WiFi routers, cellular boosters, and countless cell phones. These tests were not intended to isolate the source of the radio frequency signals but were designed to show the amount of ambient exposure that could be encountered in an area saturated with RF signals.

We can see by the data below, the radio frequency exposure that we measured during these tests was far below the levels that would be encountered by a typical cell phone or walkie-talkie when held to the user's head.

Neptune is very conscious of employee health as illustrated by the fact that we switched all bronze-body meter production to lead free alloys in 2001, over a decade before legislation was enacted to mandate use of lead free materials . Although this put Neptune at a cost disadvantage, one of the primary drivers was the concern that lead exposure might have on our employees' health.

If we thought RF was bad for us, or others, we wouldn't subject ourselves to the possibility of harm.



Results of Test at Neptune's Engineering Facility (microwatts per square centimeter)		
	Indoor Test	Meter Farm Test
Normal Range	0.01 to 0.20	0.01 to 0.20
Peak Level	1.1	7.6