Testimony for Inclusion on the record related to
HB 5867, AA Requiring the Labeling of Cellular Phones and
SB 463, AAC The Labeling of Cellular Phones
General Law Committee
Submitted by CTIA
February 22, 2011

Spoken Statement of Dr. Howard Ory

Prepared in Opposition to SB 1212

Introduction

I am Dr. Howard Ory and I appreciate the opportunity to present this information to you. I am the former Deputy Director for Epidemiology at the Centers for Disease Control.

Purpose and Summary of Testimony

I am here on behalf of the wireless industry.

Section 1 of proposed Senate Bill 1212 provides the rationale on which the legislation is based. The rationale is flawed and consequently, the legislative requirements in Section 2 are ill-conceived and should not be passed.

First, contrary to the language of Section 1, the state of the science is not provocative and is not troubling. The overall results of the animal and human studies to date do not demonstrate a causal association between cell phones and cancer. In September 2009 by the International Committee for Nonionizing Radiation Protection (ICNIRP), an independent group of scientists, reviewed all human epidemiology and concluded that there was no overall association between wireless phone use and brain cancer, even in people who used a phone for more than 10 years. Government agencies charged with regularly reviewing these data, the NCI, the FCC and the FDA have reached the same conclusion. The National Cancer Institute, states that concerns about the potential health effects of using cellular phones "and specifically the suggestion that using a cell phone may increase a person's risk of developing brain

cancer – are not supported by a growing body of research on the subject." Finally, scientists have conducted multiple studies exposing animals to high doses of RF for the life of the animals. Overwhelmingly, these studies do not report an association between wireless phone exposure and cancer, even under these extreme exposure conditions. The "provocative and troubling" language in Section 1 of the legislation is incorrect and misleading.

Second, Section 1 states that recent studies find significantly higher risks for brain and salivary gland tumors among people using cell phones for ten years or longer. This statement ignores the most recent and thorough meta-analysis of human studies of wireless phones and tumors by (ICNIRP), which concludes that there is no overall association between wireless phone use and brain cancer and that this result is true even in people who had used a phone for more than ten years.

Third, Section 1 suggests that children and teenagers are at risk for cell phone use. However, the FDA has stated, "The scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers."

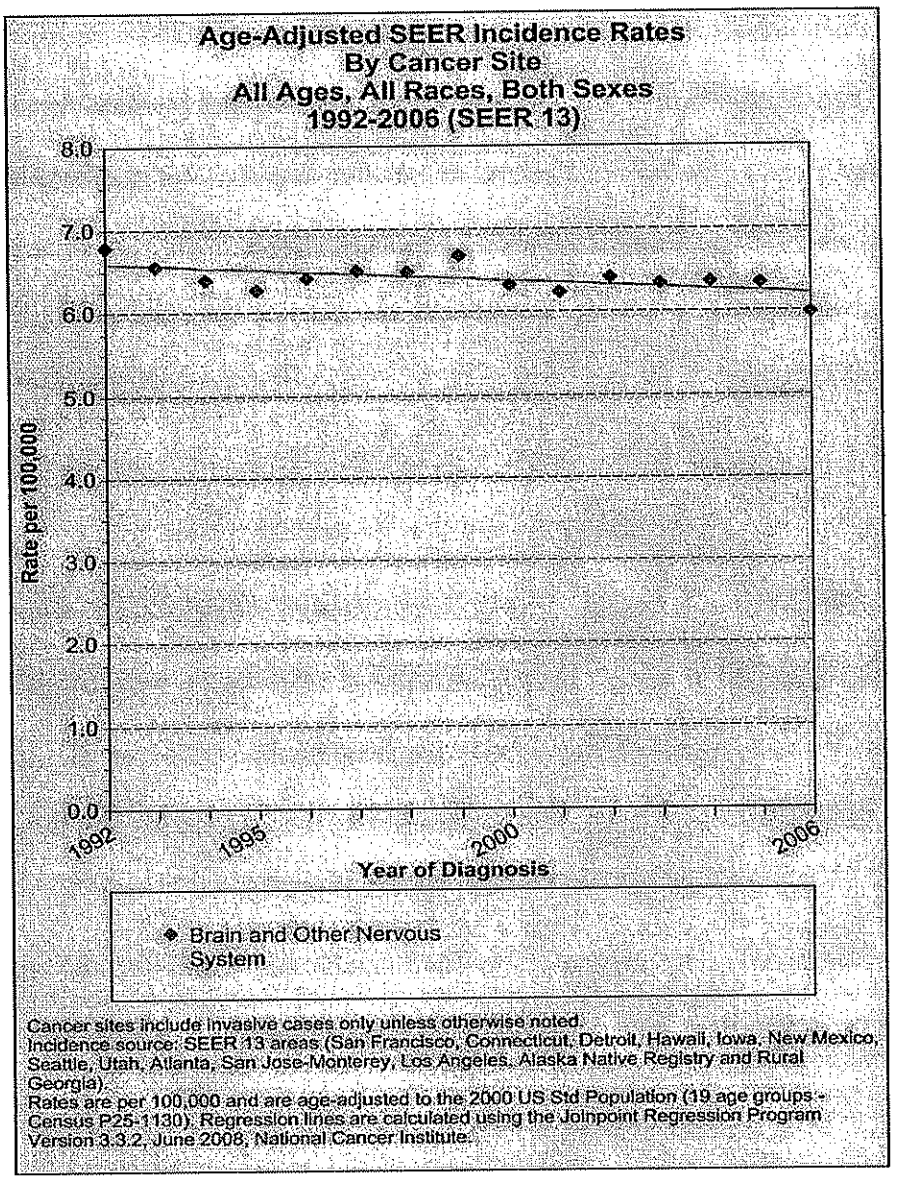
Fourth, Section 1 says that SAR values are confusing. The FCC has stated that "***ALL*** wireless phones sold in the United States meet government requirements that limit their RF energy to safe levels" http://www.fcc.gov/cgb/cellular.html and that "***ANY*** cell phone at or below FCC established SAR levels is a 'safe' phone. http://www.fcc.gov/cgb/sar/ (emphasis supplied). That is perfectly clear. On the other hand, labels stating that the wireless device emits radiation and that the SAR is a measure of radiation are very misleading. The public will likely associate "radiation," the term used in SB 1212, with "ionizing radiation"—that is, the kind of radiation that is a known

carcinogen emitted from x-ray machines and atomic bombs. Cell phones do not emit ionizing radiation and are therefore not carcinogenic. Putting the SAR value prominently on the cell phone box or on displays would lead customers to assume, that FCC-compliant cell phones with lower SAR values are somehow safer than FCC-compliant cell phones with higher SARs. Consumers would, therefore, be misled.

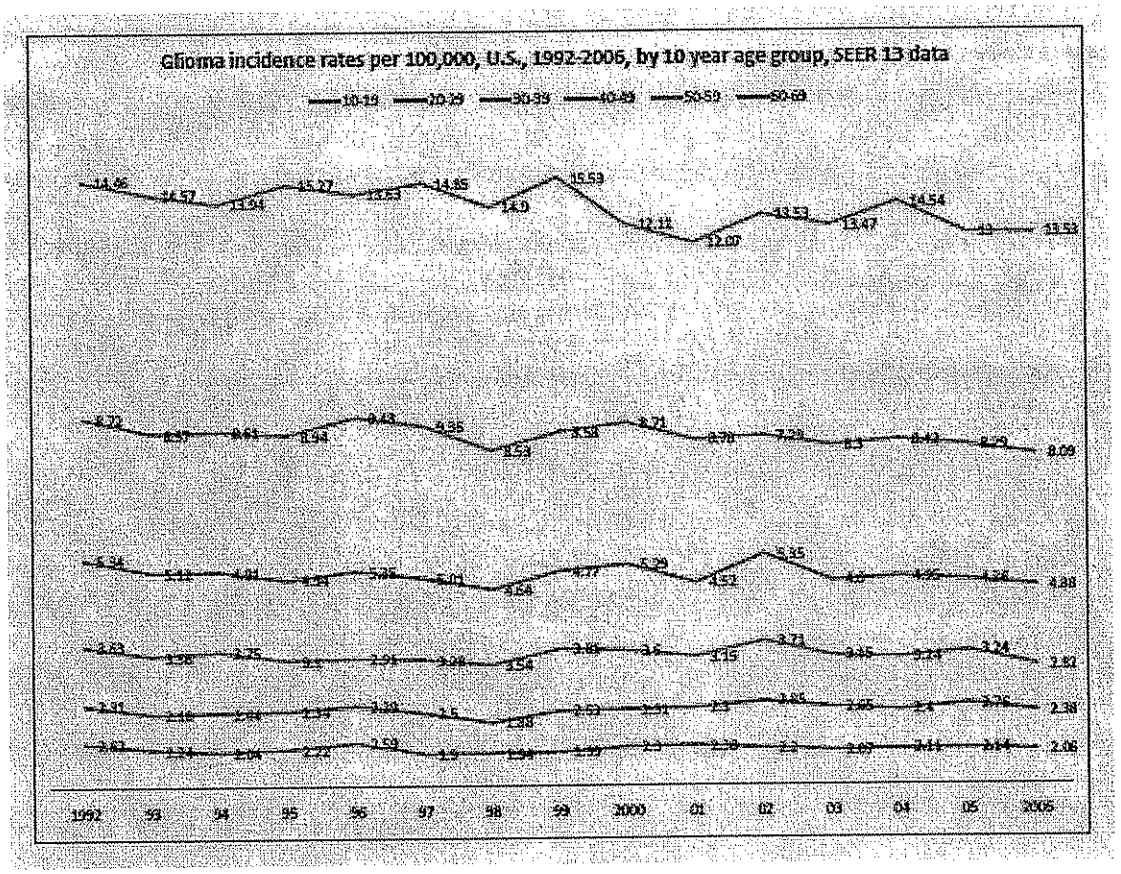
Let's turn now to the incidence of brain cancer in the US.

Brain cancer occurred long before the introduction of wireless phones. There is a natural incidence of brain cancer in the population, which includes people who use wireless phones. If wireless phone use causes brain cancer, then we would expect to see an increase in the incidence of brain cancer coincident with the use of wireless phones. We have not seen any such increase.

Please look at table 1. These US national data, collected by the National Cancer Institute show the age-adjusted incidence of brain cancer decreasing at an annual rate of 0.4% between 1992 and 2007.



Now please look at the second table which contains similar data broken out by 10 year age groups. The bottom two lines show no increase in brain cancer among children 10 to 19 years of age and young adults 20 to 29.



Don't just take my word for it. In September 2008, the National Cancer Institute (NCI), reviewed this same data and concluded that there has been no increase in the incidence of brain cancer between 1987 and 2005 despite the dramatic increase in use of cellular telephones.

Conclusion

The scientific evidence does not support Senate Bill 1212. The lack of association in the epidemiology and in the animal studies is consistent with the fact that brain cancer incidence has not increased since wireless phone use has become common in the U.S. In addition, although no epidemiologic studies have been conducted specifically in children or pregnant women, the lack

of an increase in the incidence of brain cancer, and the lack of any adverse effects in the totality of the animal data all apply equally to those populations.[1]

As a former public health official, I firmly believe that labeling requirements must be grounded in scientific fact. Scaring people about radiation risk without a scientific or medical basis for so doing and highlighting SAR information in a way that would incorrectly suggest that some compliant phones are safer than others – as SB 1212 would do – would be a serious public health mistake. I have spent my entire professional life in public health, I am a lifelong Democrat and I believe in protecting and informing consumers. I am genuinely concerned that this bill will lead to consumers being misled.

April 20, 2010

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[1] See http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116331.htm

EXPERT REPORT OF RONALD C. PETERSEN

I. BACKGROUND

A. Qualifications and Experience

My background is described in detail in my C.V., a true and accurate copy of which is attached as **Exhibit 1**. In brief, following a four-year enlistment in the U.S. Marine Corps (1954 – 1958), working as an aviation electronics technician, I attended RCA Institutes for two years. In 1961 I joined Bell Laboratories, Murray Hill, New Jersey. While working at Bell Labs, I attended the Polytechnic Institute of Brooklyn (now Polytechnic University of New York) and received the Bachelor of Science Degree in Electrical Engineering in 1968 and the Masters of Science Degree in Electrophysics in 1970.

From 1970 until I retired in 2001, I was a member of the Bell Labs Environmental Health and Safety Center, initially in the Radiation Protection and Product Safety Department and for the last five years as head of the Wireless and Optical Technologies Safety Department. In addition to Bell Labs responsibilities, the Radiation Protection and Product Safety Department and the Wireless and Optical Technologies Safety Department were the corporate (AT&T and then Lucent Technologies) resource for all radiation-related matters. Since my retirement in July 2001, I have been working as an independent consultant specializing in radiofrequency (RF) safety and FCC compliance, mainly related to personal wireless communications technology.

The main focus of my work in the Bell Labs Environmental Health and Safety Center was to evaluate the safety of all RF and laser products and systems developed by Bell Labs and manufactured by Western Electric, and all such products installed by AT&T and Lucent Technologies Inc. This included assessment of potential human exposure to electromagnetic energy, analytically and by measurement. Participation in the development of RF safety standards was an important part of my responsibilities at Bell Labs, AT&T, and then Lucent Technologies, as it required me to stay current on all RF safety issues and to assess the potential impact of any forthcoming standards and associated regulations on AT&T and Lucent Technologies products.

I have been a member of the committee now known as the Institute of Electrical and Electronics Engineers (IEEE) International Committee on Electromagnetic Safety (ICES) since 1973, during which time I served in a number of leadership roles including Chair. I currently hold the position of Executive Secretary. ICES, which developed, and continues to update as necessary, the C95 series of voluntary standards through an open consensus process, evolved from a small committee approved by the American Standards Association (now the American National Standards Institute (ANSI)) in 1960.

In addition, I have also served on and held leadership positions on a number of other committees related to the safety of RF energy. Among other positions, I was the former Chair of IEEE Standards Coordinating Committee 34 (Product Performance Relative to the Safe Use of Electromagnetic Energy) and the former Chair of the National Council on Radiation Protection and Measurements (NCRP) Scientific Committee 89—Non-Ionizing Radiation; I am the current

Chair of the International Electrotechnical Commission (IEC) Technical Committee TC-106 (Assessment of Human Exposure to Electric, Magnetic and Electromagnetic Fields).

I have also participated in a number of advisory boards and panels including the New Jersey Department of Health Vernon Valley Study where I was a member of the Science Advisory Panel representing the New Jersey Department of Environmental Protection. I have been a member of the New Jersey Non-Ionizing Radiation Advisory Committee (NJNIRAC) to the New Jersey Commission on Radiation Protection since 1976. I have served on the IEEE Standards Association Standards Board (IEEE SASB) for a number of terms and chaired the SASB New Standards Committee. I am a fellow of the IEEE and the Laser Institute of America.

B. Summary of Opinions

I have been asked to review the ordinance amending the San Francisco Environment Code, Chapter 11, sections 1100 through 1106 ("Ordinance") and the regulations and display materials promulgated by the San Francisco Department of the Environment and give my opinion as to whether the Ordinance and regulations are consistent with the scientific principles underlying the Federal Communications Commission's radiofrequency (RF) safety criteria. In this regard, my purpose is to provide an explanation of the scientific basis for RF safety standards developed by the scientific community and later adopted by the FCC. I have also been asked to give my opinion regarding whether the Ordinance, regulations, and display materials provide consumers with accurate and useful scientific information for purchasing cellular telephones. The purpose of my review is not to offer my opinion as to whether the FCC safety criteria adequately protect consumers or whether wireless phones are "safe," although I believe they are. Nor is it my purpose to opine on the validity of the Ordinance from a legal perspective. My purpose is to provide an explanation of the principles on which the scientific community reached consensus on the existing RF safety standards reflected in the federal regulations. My opinions are:

1. As a scientific matter, the maximum Specific Absorption Rate (SAR) value as reported to the FCC and required to be displayed to consumers under the Ordinance has no predictable or meaningful correlation with actual consumer exposure to RF energy. Thus, from a scientific standpoint, the SAR disclosure required by the Ordinance is misleading.

2. The Ordinance is inconsistent with the scientific principles underlying the FCC's RF safety standards. The premise of the Ordinance appears to be that using a lower SAR phone is safer. This conflicts with the scientific basis for the FCC standard—that there are established thresholds for adverse biological effects and the standards incorporate a 50-fold safety factor below those established thresholds. The apparent goal of the Ordinance is to incentivize consumers to shop for cellular phones with lower SAR values. But even if the maximum reported SAR for FCC compliance purposes could be used as a proxy for consumer exposure (which scientifically it cannot), the FCC standard is based on the scientific conclusion that differences in exposures below a SAR of 1.6 W/kg are biologically insignificant. In other words, the FCC standard is based on the conclusion that potential injury from RF exposure is a *threshold phenomenon* and

below a certain threshold there is no reliable scientific evidence that injury can occur. A common place example of this scientific principle is that a 60 watt light bulb is not "safer" to the human eye than an 80 watt light bulb—both are equally safe because they are below the threshold for potential injury. By contrast, the Ordinance, regulations, and display materials suggest to consumers that certain phones below a SAR of 1.6 W/kg are safer than other phones below a SAR of 1.6 W/kg. This premise conflicts with the scientific judgment underlying the FCC standard itself.

3. The Ordinance also requires cellular telephone retailers to use a definition of "SAR" that is inaccurate and misleading. SAR is not a "type" of RF energy as described in the City's mandated disclosures; rather, it is the measure of the rate of RF energy absorbed by the body from the source being measured. The Ordinance also requires retailers to use the term "radiation," which is misleading in and of itself because it fails to distinguish between ionizing radiation (such as from nuclear reactions or X-rays) and non-ionizing radiation (such as RF energy which cell phones emit and is incapable of breaking even the weakest chemical bonds in the body).

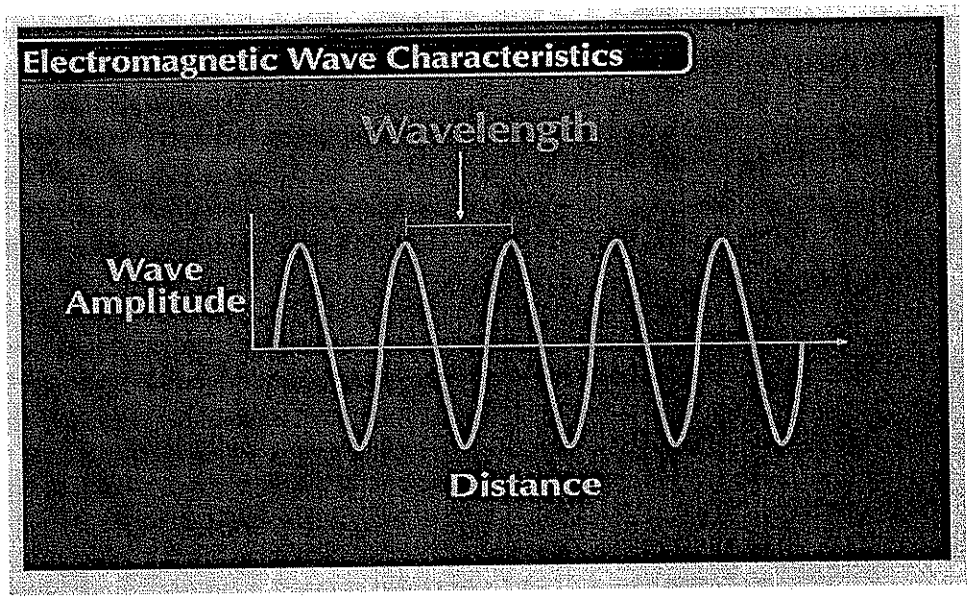
II. OPINIONS

A. Background of Electromagnetic Theory

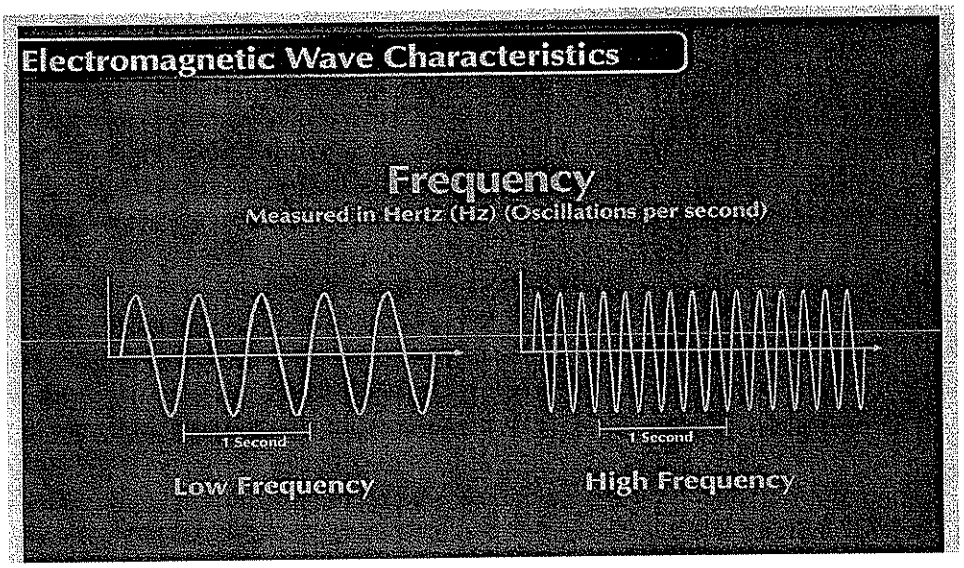
There are certain concepts related to electromagnetic theory that are helpful in understanding: (1) the important difference between ionizing radiation and non-ionizing radiation; (2) the characteristics of radiofrequency energy emitted from wireless phones; and (3) the scientific measure of RF energy, which is called specific absorption rate or "SAR". These are principles that provide the scientific foundation for the FCC RF exposure standards.

1. In general, the term "radiation" means the propagation of energy in the form of electromagnetic waves or particles. Some people may hear the term "radiation" and think of nuclear radiation, cosmic radiation, gamma radiation, X-radiation, and other forms of high energy radiation that can remove an electron from a simple atom (cause "ionization") or break chemical bonds and cause harm to humans. It is important to understand that radiofrequency energy, infrared, visible light, and ultraviolet light are also forms of radiation but have insufficient energy to cause ionization or break chemical bonds. Thus, while seated in a lighted room, one is exposed to incandescent or fluorescent radiation, or while outside to solar radiation, and at night to solar radiation reflected from the moon.

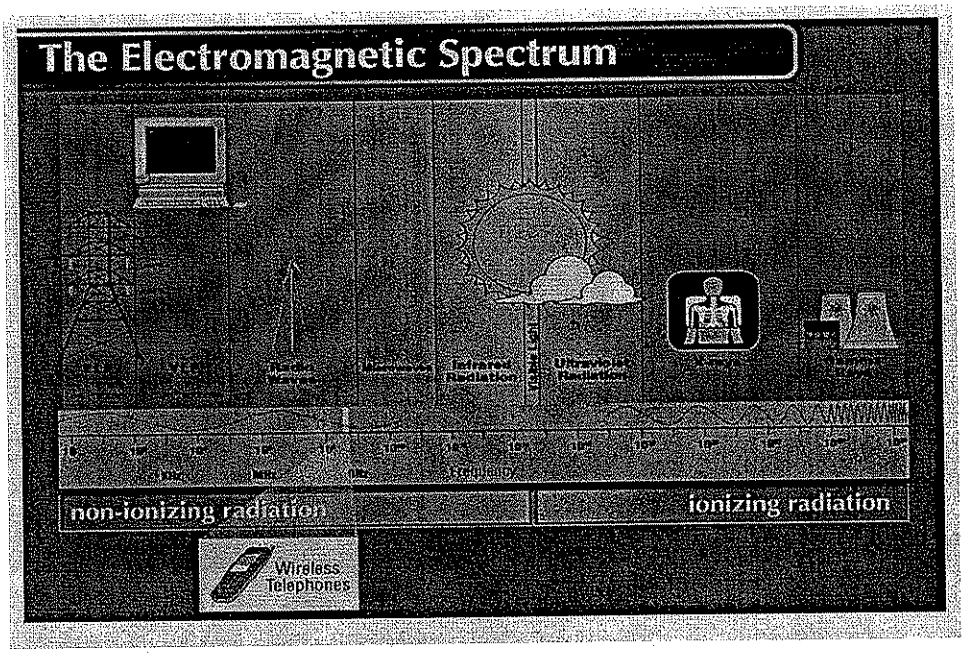
The difference between different types of radiation is defined by the concepts of electromagnetic waves and frequency. Electromagnetic waves are comprised of oscillating electric and magnetic fields that travel at the speed of light. The wavelength of an electromagnetic wave is the distance between two points of the same phase on consecutive cycles of a wave (analogous to the distance between two peaks of an ocean wave), which is related to the velocity and frequency of the wave.



The frequency of the wave, measured in cycles per second, or hertz (Hz), where one Hz equals one 1 cycle per second, is analogous to the number of times the peak amplitude of the ocean wave passes a stationary point per unit time).



The electromagnetic spectrum is a graphical way of depicting the continuum of electromagnetic energy.



Radiation associated with frequencies greater than about 3000 million-MHz is called "ionizing radiation" because the energy associated with such radiation is sufficient to directly remove an electron from a simple atom (produce an ion), or disrupt a chemical bond of a simple molecule. Regarding adverse biological effects, scientific organizations use a zero-threshold linear dose-response model for setting safety standards. The model assumes that any exposure can cause an adverse biological effect and the effect of an exposure is cumulative. Thus, for ionizing radiation, there exists a cumulative dose associated with the magnitude of the exposure and the exposure duration. Gamma rays, X-rays, and nuclear radiation are forms of ionizing radiation.

Radiation at frequencies below about 3000 million MHz is called "non-ionizing radiation" because the associated energy is not sufficient to remove electrons from atoms. Regarding adverse biological effects, the relevant standard-setting bodies have concluded that the weight of the scientific evidence supports a threshold for adverse effects below which such effects do not occur, i.e., until a specific threshold is reached, there are no harmful effects, regardless of the exposure duration. Radiofrequencies, infrared radiation, visible light, and the longer ultraviolet wavelengths are all forms of non-ionizing radiation.

2. Radiofrequency energy is used for communications, e.g., AM, FM, and TV broadcast, personal wireless communications services such as cellular telephones, cordless telephones in the home, and two-way radios for police and other emergency services. Radiofrequencies are also used for navigation systems such as Loran, radar, the global satellite positioning system (GPS), and for consumer products such as automatic garage-door openers, intrusion alarms, baby monitors, radio-controlled toys, and wireless Internet access in the home, e.g., wireless local area networks (WiFi).

Wherever one turns on a radio, television, cell phone, or other radio device and receives a signal, that person and others nearby are exposed to radiofrequency energy. Consumers are

exposed to the electric and magnetic fields associated with countless other devices including electric shavers, clock radios, computers, copiers, and microwave ovens, to name a few. Indeed, all objects are constantly emitting and absorbing electromagnetic energy. The human body itself naturally emits at least 15 watts (W) of infrared radiation. In contrast, the maximum power of a cellular telephone is 0.6 W, and of that total, less than half would be absorbed in the head and hand of the user.

3. The scientific measure for RF energy exposure from using hand-held and similar portable RF devices is the Specific Absorption Rate. SAR is a measure of the rate at which energy is absorbed by an object in an incident electromagnetic field per unit mass of the absorbing object. Put another way, SAR measures the actual rate at which energy is deposited in an absorbing object, such as the human head, averaged over a specified mass of tissue.

SAR was first proposed (defined) by the National Council on Radiation Protection and Measurements (NCRP Report No. 67) in 1981 as a means to help researchers and others compare the results of research carried out at different frequencies and under differing exposure conditions. For example, the same laboratory animals, such as mice or rats, could be exposed to electromagnetic waves of the same intensity but the energy absorbed could be markedly different depending on the size and orientation of the animal in the field, the frequency of the incident wave, etc. The adoption of SAR allowed direct and meaningful comparisons of research results obtained under differing exposure conditions.

Science-based contemporary RF safety standards and guidelines are based on a threshold SAR, below which adverse effects have not been demonstrated. To ensure an adequate margin of safety, the standards reduce the threshold SAR value by a factor 10 for exposures in controlled environments (e.g., the workplace in which people are aware of and can control their exposure) and a factor of 50 for exposures in uncontrolled environments (e.g., the home, the general public in which people are generally unaware of or cannot control their exposure). These values are called basic restrictions. NCRP and IEEE in 1986 and 1991 respectively adopted a specific standard for peak spatial-average SAR value of 1.6 watts per kilogram (W/kg) in any 1 gram of tissue for localized (as opposed to whole body) exposure. The FCC adopted this standard in 1996. The International Commission on Non-ionizing Radiation Protection (ICNIRP) adopted less conservative values of 2 W/kg in any 2 grams of tissue for uncontrolled environments localized exposure, which is the value recently adopted in the IEEE C95.1-2005 standard.

B. FCC Rulemaking and Adoption of the 1996 RF Safety Criteria

In 1992, the American National Standards Institute (ANSI) approved for use as an American National Standard the safety standard for RF exposure developed by IEEE Standards Coordinating Committee 28 (IEEE C95.1-1991), which the FCC refers to as ANSI/IEEE Std C95.1-1992. The FCC subsequently initiated a rulemaking procedure on whether to change its safety regulations, which had been based on the 1982 ANSI standard (ANSI C95.1-1982).

In August 1996, with input from the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA), the FCC adopted the current RF exposure criteria applicable to all wireless phones marketed and sold in the U.S. *In re Guidelines for Evaluating the*

Environmental Effects of Radiofrequency Radiation, Release No. 96-326, 11 F.C.C.R. 15123, 15184 (¶ 169) (1996). These regulations for human exposure were derived from the NCRP recommendations and the IEEE standard. *FCC, Radiofrequency Safety: Frequently Asked Questions,* available at http://www.fcc.gov/oet/rfsafety/rf-faqs.html.

As discussed in more detail below, both the NCRP recommendations and IEEE standard were developed by committees of expert scientists and engineers after extensive reviews of the scientific literature related to RF biological effects. The exposure guidelines are based on thresholds for established adverse effects, and they include a significant margin of safety based on those thresholds. *FCC, Radio Frequency Safety: Frequently Asked Questions,* available at http://www.fcc.gov/oet/rfsafety/rf-faqs.html.

The regulation applicable to wireless handsets establishes a maximum SAR of 1.6 W/kg for spatial peak SAR as averaged over any one gram of tissue. 47 C.F.R. § 2.1093(d)(2). This value is based on the FCC's safety criteria for "general population/uncontrolled" exposure environments. This regulation assumes that users lack knowledge or control of their RF exposure and, as such, sets the exposure limit at a low enough level to eliminate the need for any warnings. 47 C.F.R. § 1.1307(b)(1) (table).

Before any manufacturer can market, sell or distribute a wireless handset in the United States, the manufacturer must have the phone tested to ensure compliance, and submit a "statement affirming that the equipment complies" with the applicable SAR standards "as measured by an approved method," and "to maintain a record showing the basis of the statement of compliance." 47 C.F.R. § 24.52. The FCC adopted the requirements of the IEEE 1528-2003 standard as the "approved method" for measuring compliance with applicable SAR standards. According to the FCC, any phone certified at or below the FCC's SAR level (1.6 W/kg) is a "safe" phone. *FCC, Cellular Telephone Specific Absorption Rate,* available at http://www.fcc.gov/cgb/sar.

C. NCRP Recommendations and IEEE Guidelines

In order to understand the tenets of the FCC's RF safety regulation, one must understand the work of the two organizations upon which the FCC based its safety criteria—the NCRP and IEEE, as well as the work by the IEEE in establishing the compliance testing standard adopted by the FCC.

1. NCRP Report No. 86

NCRP is a non-profit, technical, professional society chartered by Congress in 1964. Its objectives are to:

- collect, analyze, develop, and disseminate in the public interest information and recommendations about (a) protection against ionizing and non-ionizing radiation and (b) radiation measurements, quantities and units, particularly those concerned with radiation protection;

- provide a means by which organizations concerned with the scientific and related aspects of radiation protection and of radiation quantities, units, and measurements may

cooperate for effective utilization of their combined resources, and to stimulate the work of such organizations;

- develop basic concepts about radiation quantities, units, and measurements, about the application of these concepts, and about radiation protection;

- cooperate with ICNIRP, the Federal Radiation Council, the International Commission on Radiation Units and Measurements, and other national and international organizations, governmental and private, concerned with radiation quantities, units, and measurements and with radiation protection.

NCRP, About NCRP, available at http://www.ncrponline.org/AboutNCRP/About_NCRP.html. In the mid-1970s, NCRP Scientific Committee 53 (SC-53 – now SC-89-5) was established to review the scientific literature and recommend limits for exposure to RF/microwave energy. NCRP SC-53 was organized and began its work in 1981. In 1986, the SC-53 literature review was published with exposure criteria for RF electromagnetic fields (NCRP Report No. 86).

2. ANSI/IEEE C95.1-1992

The IEEE is the world's largest professional association whose stated mission is "to foster technological innovation." Its membership consists of 395,000 individual members in 160 countries, 45% of whom are outside the United States. IEEE and its members produce widely used scientific publications and technology standards and sponsor a wide array of respected conferences and professional and educational activities. *IEEE, About IEEE,* available at http://www.ieee.org/about/index.html.

The IEEE International Committee on Electromagnetic Safety ("ICES") develops the C95 series of standards. The IEEE C95.1 standards result from a critical expert review and evaluation of the relevant scientific literature. All studies that report effects that could be related to human health are included—there are no preconceptions as to interaction mechanisms, e.g., "thermal" or "non-thermal." The committee looks at the weight of the scientific evidence to determine whether the existing standard is adequate or whether scientific evidence supports its revision.

It should also be noted that of the 125 members of the subcommittee that participated in the development of ANSI/IEEE C95.1-1992, approximately 30% were from university research laboratories, 6% were from non-profit research laboratories, 12% from military research laboratories, 24% were representatives of federal public health agencies, including the EPA, the FDA, NIOSH, and OSHA, 10% were from industry, 3% consultants to industry, 4% from government administrative offices, and 11% were independent consultants or represented the general public. Approximately 33% were physical scientists (physics, biophysics, engineering, etc.), 43% were life scientists (biology, genetics, etc.), 10% were physicians and research physicians, 3% were radiologists, toxicologists, pharmacologists, and 11% were from the law, safety, and medical professions.

3. Key Points from NCRP Report No. 86 and ANSI/IEEE C95.1-1992

I have attached as **Exhibit 2**, a comprehensive history of the development of safety standards for RF exposure, including NCRP Report No. 86 and ANSI/IEEE C95.1-1992. I have attached as **Exhibit 3** a paper describing the specific details of the development of ANSI/IEEE C95.1-1992. However, there are several key points I would like to emphasize from the development of these standards, which formed the basis of the FCC RF safety standards.

- The possibility of "non-thermal" effects and mechanisms has come up a number of times during the past five decades. Because of this, NCRP and IEEE ensure that all relevant studies are included in the literature reviews and evaluations, whether the proposed mechanism is thermal or non-thermal. Indeed, the IEEE standard is based on thresholds for the most sensitive, reproducible biological effect that could be related to adverse effects in humans regardless of the nature of the interaction mechanism.

- Both NCRP and IEEE identified a whole-body-averaged SAR as the ***threshold*** above which adverse effects in humans could occur. They then added a safety factor of 10 to arrive at the basic restriction for exposures in controlled environments. Both NCRP and IEEE recommended a further layer of protection for exposures in uncontrolled environments (i.e., general public as opposed to workers) of an additional factor of 5. It was assumed that those in uncontrolled environments have no knowledge or control of their exposure. It is important to note that both the NCRP and IEEE basic restrictions are developed to apply to continuous, indefinite exposure 24 hours a day, every day.

- In developing the 1991 standard, the IEEE stated that: "The members of Subcommittee 4 believe the recommended exposure levels should be safe for all, and submit as support for this conclusion the observation that no reliable scientific data exist" that, among other things, certain subgroups (e.g., infants, the aged, the ill) are more at risk than others or that non-thermal exposure "may be meaningfully related to human health." This position remains the same in the 2005 C95.1 standard and in contemporary safety guidelines developed by others, e.g., ICNIRP. Thus, any assertion that the standards do not apply to children is incorrect.

- The IEEE C95.1 standards are living documents, meaning that the committees remain active, continually review and evaluate the scientific literature, and incorporate necessary changes into amendments and revisions of the standard. The standards-setting organizations and federal agency representatives, including the FCC, keep abreast of the latest studies and developments by actively participating on the IEEE committee and through interactions between the IEEE committee and the Interagency RF Work Group. This ongoing process led to a Supplement and an Amendment to the 1991 standard, published in 1999 and 2004, respectively. A complete revision of IEEE C95.1-1991 was approved by the IEEE SASB in 2005 and published and approved by ANSI in 2006. The stated purpose of the 2005 standard is to provide recommendations to protect against established adverse effects to human health associated with exposure to RF electric, magnetic, and electromagnetic fields over the frequency range of 3 kHz to 300 GHz.

- The IEEE 2005 standard confirms the position of the IEEE ICES that the basic restrictions of the 1991 standard, NCRP Report No. 86 and therefore the FCC MPE values, adequately protect human health.

4. IEEE Standard for Assessing Compliance of Mobile Telephones (IEEE 1528-2003/2005)

IEEE Standards Coordinating Committee 34, which was organized in 1995, developed IEEE Standard, 1528-2003, which is entitled IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. IEEE 1528-2003 describes a protocol for peak spatial-average SAR compliance assessment that utilizes anthropomorphic-shaped phantoms of the human head made of a plastic or fiberglass shell filled with homogeneous tissue equivalent liquid. The standard phantom shape is derived from the size and dimensions of the 90th-percentile adult male head with the ears adapted to represent the flattened ears of the mobile phone user.

The device to be measured, e.g., a cell phone, is placed in a number of specified positions on each side of the phantom head and the SAR in the tissue-equivalent liquid is determined by scanning along the interior of the phantom shell with a miniature electric field probe. Once the regions of highest SAR are identified, post-processing algorithms are used to average the local SAR over a prescribed volume, i.e., a cubic volume equal to 1 g of tissue. Measurements are made with the phone operating at maximum power at the low, mid and high frequency channels of each band at which the phone operates and at each operating mode, e.g., CDMA, GSM, LTE. Similar measurements are made using a phantom representative of other portions of the body, e.g., the hip. Typically, tests are required in more than 20 different positions and operating conditions. The maximum SAR corresponding to each of the numerous specified positions and operating conditions are recorded.

The phantom size and shape and the electrical properties of the tissue-equivalent liquid "head" tissue are standardized. Although individual persons vary considerably in features, it is important to have a well defined reference phantom model with which to perform peak spatial-average SAR measurements. A reference phantom allows for better comparisons of results from all laboratories and prevents minor differences between phantoms from obscuring agreement or disagreement of results. The phantom shape and size, the electrical properties of the tissue equivalent liquid, the specific test positions and handset operating configurations and all measurement uncertainties are selected to ensure that the measured SAR values are conservative, i.e., that they consistently exhibit a slight overestimation compared with results obtained with an equivalently shaped heterogeneous head model, such that a compliant phone will not exceed a SAR of 1.6 W/kg under actual use conditions of person using a mobile telephone. In addition to the IEEE standard, the International Electrotechnical Commission (IEC) published similar standards in 2005 (IEC 62209-1) and 2010 (IEC 62209-2) that are in harmony with the IEEE standard.

D. The San Francisco Ordinance Is Scientifically Flawed

1. Overview of San Francisco Ordinance

The Ordinance requires all retailers of cellular telephones to make certain disclosures related to the maximum SAR values reported to the FCC as part of the product certification process. **Exhibit 4.** The Ordinance identifies as one of the reasons for its adoption that: "Government agencies and scientific bodies in the European Union (EU) and Israel have recognized the potential harm of long-term exposure to radiation emitted from cell phones and, as a result, have issued warnings about their use, especially their use by children." Ordinance, Section 1(a). The Ordinance further states that "consumers are not able to make informed purchasing decisions because there is no requirement that retailers provide the applicable SAR values to the consumer at the point when the consumer is deciding between various makes and models." Ordinance, Section 1(c). The Ordinance further states that "radiation exposure from cell phones can be reduced by using a speakerphone or a headset, or by sending text messages." Ordinance, Section 1(d).

Section 1103 of the Ordinance requires retailers to post display materials in connection with sample phones or phones on display that include three elements ("Sample Display"): (1) the maximum SAR value of that phone and the maximum allowable SAR value for cellular telephones set by the FCC; (2) a statement explaining what a SAR value is; and (3) a statement that additional educational materials regarding SAR values and cellular telephone use are available upon request from the cellular telephone retailer.

Further, retailers that do not post Sample Display materials in connection with sample phones or phones on display must display a poster within the retail location visible to the public that includes the following three elements ("Poster Display"): (1) the maximum SAR value of each make and model of cellular telephone offered for sale or lease at that retail location and the maximum allowable SAR value for cellular telephones set by the FCC; (2) a statement explaining what a SAR value is; and (3) a statement that additional educational materials regarding SAR values and cellular telephone use are available upon request from the cellular telephone retailer.

The Ordinance requires the City's Department of Environment to specify the "content and format" for the Sample Display and Poster Display, as well as "additional educational materials" that in a "Fact Sheet" to be "available from the cell phone retailer" for consumers. The Fact Sheet tells consumers that if they "are concerned about cell phone radiation," they should buy a cell phone "with a lower maximum radiation (SAR) level." On October 12, 2010, the Department of Environment issued its regulations providing the content for the Sample Display, Poster Display, and Fact Sheet. **Exhibit 5.** The required content and format for the Sample Display, Poster Display, and "Fact Sheet" are attached as **Exhibits 6, 7, and 8**, respectively.

2. The City's Premise That SAR Values Used for FCC Compliance Purposes Can Be Used by Consumers to Purchase Safer Phones Is Scientifically Invalid and in Conflict with the IEEE Standard and NCRP Recommendations Adopted by the FCC

The premise underlying the Ordinance is that by requiring retailers to display the reported maximum SAR levels for phones consumers can choose phones with lower maximum SARs and thereby: (1) reduce exposure to radiofrequency emissions; and (2) increase safety (or at least increase the margin of safety against potential risks). This premise is scientifically flawed and conflicts with the scientific and technical underpinnings of the standards and recommendations developed by the IEEE and NCRP and adopted by the FCC. Choosing a phone with a lower maximum SAR as determined during product certification does not mean that the consumer will reduce his or her exposure to RF energy from using that phone. Actual exposure depends on a number of factors including the operating power of the phone, how the phone is held during use and where it is used. Thus, the maximum SAR number cannot be used as a proxy for actual exposure. From a scientific and technical standpoint, to suggest there is a predictable or meaningful correlation between the maximum SAR value reported to the FCC and actual consumer exposure during normal use is misleading. In addition, the idea that purchasing a lower-SAR phone (within the FCC limits) provides any safety benefit directly conflicts with the key scientific premise behind the NCRP and IEEE standards, which is that the limits in those standards are set well below the ***threshold*** above which adverse effects in humans could potentially occur.

a. Maximum Reported SAR Is Not a Proxy for Consumer Exposure to RF Energy from Cellular Telephones

The reported maximum SAR value is not a reliable indicator of the overall amount of radiofrequency energy from a given phone as compared with other phones. The maximum SAR value reported to the FCC for product certification is the maximum SAR value achieved in any one of the many testing positions required at the head or body under the testing protocol adopted by the FCC and based on IEEE-1528-2003. Actual SAR during consumer use of cellular phones varies constantly depending on a number of factors. Those factors include the operating power (which itself is dependent upon the distance from a base station, topography, phone efficiency, location of the caller, among other things), how the consumer uses the phone (e.g., against the side of the head, which side of the head, against the hip, texting), the physical characteristics of the user, and the type of service and frequency band on which the phone is operating. The number and importance of these variables means that there is no meaningful correlation between the maximum SAR value as reported to the FCC and actual SAR exposure that a consumer will experience during normal use of a cellphone.

The most important variable is operating power. Cell phones constantly vary their power to operate at the minimum power necessary for communications; operation at maximum power (where the phones are tested for purposes of determining the maximum SAR) occurs infrequently. *FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html. How the phone is used by the consumer—speaker phone, at the ear, at the body, with a headset, etc.—will affect exposure. Where the phone is used— city, country, in buildings, outside, etc.—will affect the output power and thus

the SAR. The frequency level at which the phone operates during any particular call will also affect exposure. Thus, it will be highly unlikely that two phones with the same reported SAR will result in the same actual exposure of the user. One cannot conclude that one phone with a lower reported SAR than another phone will result in lower actual exposure. For example:

- Phone A might have one measurement that was higher than any single measurement for Phone B, and would therefore have a higher reported SAR than Phone B, even if the average SAR measurements for Phone B were higher than the average measurements for Phone A. In such a case, the consumers actual exposure could be greater from Phone B (the phone with the lower reported SAR), and in choosing Phone B over Phone A would be making a decision on an incorrect assumption.

- Phone A may also communicate more efficiently than Phone B, so that it operates at lower power than Phone B under comparable conditions. In such a case, a user might be exposed to higher levels of RF energy overall from Phone B (a phone that has a lower maximum SAR, but operates less efficiently than Phone A). Again, a consumer choosing Phone B over Phone A simply based on Phone B's reported lower maximum SAR would be choosing a phone that actually exposes him to more RF energy.

- Phone A may have a higher maximum SAR than Phone B, but the highest SAR for Phone A may have been measured at a position that the consumer may never/seldom use (e.g., the hip). At the position that the consumer may more commonly use (e.g., the head), the SAR for Phone B may be higher. Thus, a consumer may select Phone B based on a comparison of the maximum SAR numbers without knowing that Phone B has a higher SAR than Phone A in the position more commonly used by the consumer.

- A consumer might choose Phone B with the lower maximum SAR but live in an area where the network for Phone B is less accessible to the phone, i.e., the phone has to operate at higher power in general than Phone A would have to operate in the same location. In that case, exposure from Phone B might be higher.

- The frequency band over which the phone operates is also important. Whereas phones are tested at each frequency band where they operate, the value reported is the maximum measured, regardless of the band in which it occurs. For example, while the reported value for phone A might be higher than that for phone B in the 800 MHz frequency band, the opposite may be true for the 1900 – 2100 MHz band. Depending on the frequency band of the subscriber's service, the phone with the lower reported SAR could result in a higher exposure than the phone with the higher reported SAR.

A phone's maximum SAR used for compliance testing only provides the maximum value among many measurement test values. Scientifically, the maximum value cannot be used as a proxy for consumer exposure. The FCC has expressly made this point: "FCC approval means that the device [cell phone] will never exceed the maximum levels of consumer RF exposure permitted by federal guidelines, but it does not indicate the amount of RF exposure consumers experience during normal use of the device." *FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html. "[A] single SAR value does not provide sufficient information about the amount of RF exposure under typical usage

conditions to reliably compare individual cell phone models. Rather, the SAR values collected by the FCC are intended only to ensure that the cell phone does not exceed the FCC's maximum permissible exposure levels even when operating in conditions which result in the device's highest possible – but not its typical – RF energy absorption for a user." *FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html. The FCC's position is consistent with the scientific and technical realities of the compliance testing SAR compared to actual exposure conditions.

b. The Premise That Lower SAR FCC-Compliant Phones Are "Safer" Than Other FCC-Compliant Phones Conflicts Scientifically with the Standards Adopted by the FCC

San Francisco's premise that using a lower SAR phone (within the FCC-approved limit) is safer and reduces any risk of "cancer and other illnesses" is inconsistent with the core principle of the NCRP recommendations and IEEE standards adopted by the FCC. The basic restrictions adopted by the FCC are based on established thresholds for adverse biological effects with added safety factors to ensure a wide margin of safety. The IEEE standards and NCRP recommendations are based on their scientific conclusion (adopted by the FCC) that any potential injury from exposure to RF energy is a threshold phenomenon—below a certain threshold no injury has been demonstrated to occur. Under that scientific premise, the implication that a cell phone with a maximum reported SAR value of .08 is safer than a cell phone with a maximum reported SAR value of 1.6 is false. Based on the scientific principles underlying the standards, both phones are safe and both phones are equally safe. The principle is analogous to that involved in judging the safety of a 60 watt light bulb versus an 80 watt light bulb. Both bulbs are significantly below the threshold energy level at which injury to the human eye could occur. One bulb is not "safer" than the other and it would be scientifically inaccurate and misleading to suggest to consumers that the 60 watt bulb was "safer."

Consistent with these principles, the FCC stated that its RF exposure standard, "**is set at a level well below that at which laboratory testing indicates, and medical and biological experts generally agree, adverse health effects could occur.**" *See FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html. The FCC advises consumers that: "Many people mistakenly assume that using a cell phone with a lower reported SAR value necessarily decreases a user's exposure to RF energy, ***or is somehow 'safer' than using a cell phone with a high SAR value.***" *FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html. The FCC's statements are consistent with the premise of the standards and recommendations developed by IEEE and NCRP—the exposure limits and basic restrictions protect against all established adverse effects, and any conclusion that a lower SAR within the FCC limits somehow results in greater safety is contrary to scientific principles underlying the standard.

c. The City's Definition of SAR and Use of the Term "Radiation" Are Scientifically Invalid and Misleading

The Sample Display, Poster Display and Fact Sheet talk about "radiation" without distinguishing between "ionizing" and "non-ionizing" radiation. "Radiation," as used in the San Francisco materials, is often used to imply that ionizing radiation – or radioactivity – such as that associated with X-rays and nuclear power plants is present. Ionizing radiation should not be confused with—and, indeed, must be distinguished from—the lower-energy, non-ionizing radiation (such as the RF energy from mobile phones, infrared radiation and visible light) with respect to possible biological effects, since the mechanisms of interaction are quite different. *See FCC, Radiofrequency Safety: Frequently Asked Questions,* available at http://www.fcc.gov/oet/rfsafety/rf-faqs.html.

The San Francisco materials are also incorrect in how they define SAR. The materials define SAR as "a measure of the type of radiation absorbed by the head and body when using a cell phone." SAR is a "measure of the rate [not type] of RF (radiofrequency) energy absorption by the body from the source being measured – in this case, a cell phone." *FCC Consumer Facts, SAR For Cell Phones: What It Means For You,* available at http://www.fcc.gov/cgb/consumerfacts/sar.html.

d. The Ordinance Is Inconsistent with the Setting of a Two-Tiered Standard with Lower Basic Restrictions and MPE Values for the General Public

The lower-tier basic restrictions and the corresponding exposure limits developed by NCRP and IEEE are based on the assumption that the general public has no knowledge of or control over RF exposure. Indeed, this lack of control over exposure was one of the primary reasons for adopting such a wide safety margin in the maximum SAR values established for the general public. The Ordinance is based on the proposition that the dissemination of RF advisories to the general public is necessary for consumer safety purposes, which is contrary to the two-tiered approach established by NCRP and IEEE as adopted by the FCC.

III. Publications, Prior Testimony, and Compensation

A. Publications in Previous Ten Years

Osepchuk, J. M. and Petersen, R. C., "Safety and Environmental Issues," In: *The RF and Microwave Handbook*, M. Golio, ed., CRC Press LLC, Boca Raton, FL, pp. 3.28-3.43, 2001

Osepchuk, J. M. and Petersen, R. C., "Safety Standards for Exposure to Electromagnetic Fields," *IEEE Microwave Magazine*, Vol. 2, No. 2, pp. 57-69, June 2001.

Adair, E. R. and Petersen, R. C., "Biological Effects of Radio Frequency/Microwave Radiation," *50th Anniversary Volume – IEEE Transactions on Microwave Theory and Techniques*, Vol. 50, No. 3, pp. 953-962, March, 2002.

Mason, P. A., Murphy, M. R. and Petersen, R. C., "IEEE EMF Health and Safety Standards," Presented at: *WHO Meeting on EMF Biological Effects and Standards Harmonization in Asia and Oceania* – October 22-14, 2001.

Osepchuk, J. M. and Petersen, R. C., "Comments on 'Non-Thermal Effects' of Extremely High-Frequency Microwaves on Chromatin Conformation in Cells *In Vitro* – Dependence on Physical, Physiological, and Genetic Factors," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 50, No. 7, pp. 1856, July 2002.

Osepchuk, J. M. and Petersen, R. C., "Historical Review of RF Exposure Standards and the International Committee on Electromagnetic Safety (ICES)," *Bioelectromagnetics,* Vol. 24, No. S6, pp. S7-S16. 2003.

Chou, C-K., D'Andrea, J. A., Tell, R. A., Sheppard, A. R., Heynick, L. N., Swicord, M. L. and Petersen, R. C., "Progress of the C95.1-1991 RF Safety Standard Revision," Meeting Abstract – Presented at: "*The 3rd International Seminar on Electromagnetic Fields and Biological Effects*," Guilin, China, October, 2003.

Adair, E. R., Osepchuk, J. M., Bodemann, R., Petersen, R. C., Varanelli, A. G., and McManus, T. "Radiation Misinformation" *IEEE Spectrum*, December 2002.

Petersen, R. C., "An Overview of ELF and RF Exposure Standards," Abstract: (Invited Presentation—Asia-Pacific EMF Conference, Bangkok, Thailand – January 27, 2004).

Petersen, R.C., Response to "A Biological Guide for Electromagnetic Safety: The Stress Response," M. Blank and R. Goodman, *Bioelectromagnetics*, Vol. 25, No. 8, pp. 647-648, 2004.

Petersen, R.C., ICES Reply to Comment on "Reviews of the Effects of RF Fields on Various Aspects of Human Health," [*Bioelectromagnetics*, Supplement 6 (2003)], Vol. 26, pp. 159-160, 2005.

Murphy, M.R., and Petersen, R.C., "The International Committee on Electromagnetic Safety (ICES): Safety Standards for Electromagnetic Energy," *Proceedings of Bioelectromagnetics 2005*, Dublin Ireland. June 2005.

Chou, C-K., D'Andrea, J. A. Tell, R. A. Adair, E. R. Swicord, M. L. Lang, S, DeFrank, J. Petersen, R. C. "Update on the Revision of IEEE Std IEEE C95.1-1991 (RF Safety). Presented at the 4th International Seminar on Electromagnetic Fields and Biological Effects, September 12-16, 2005, Kunming, China.

Murphy, M. R., Petersen, R. C., Bodemann, R., "The IEEE International Committee on Electromagnetic Safety (ICES): Safety Standards for Electromagnetic Energy," Presented at the International Union of Radio Science (URSI) General Assembly, October 23-29, 2005, New Delhi, India.

Chou, C-K., D'Andrea, J.A., Tell, R.A., Reilly, J P, Adair, E.A., Swicord, M.L., Lang, S., DeFrank, J., Petersen, R.C., "New IEEE C95.1-2005 RF Safety Standard," Presented at BEMS (Bioelectromagnetics Society) 2006, Cancun MX, June 2006.

C-K. Chou, John A. D'Andrea, Richard A. Tell, J. Patrick Reilly, Eleanor R. Adair, Mays L. Swicord, Sakari Lang, John J. DeFrank, Ronald C. Petersen, "New features in the IEEE C95.1-2005 RF exposure standard," in "Biological Effects of EMFs - 4th International Workshop" in Crete, Greece, Vol. 1, pp. 317-325, 2006. SET:960-233-171-2, ISBN: 960-233-172-0.

Murphy, M, R. and Petersen, R.C., "Developing Safety Standards for Electromagnetic Energy: The IEEE International Committee on Electromagnetic Safety (ICES)," Presented at "IEEE Engineering in Medicine and Biology – 06," September 2006.

Petersen, R.C., "Radiofrequency Safety Standards." In: *Radiofrequency Dosimetry Handbook*, P. Chadwick and P. Mason (eds.). In press.

Chou, C-K, and Petersen, "Radio Frequency Exposure and Compliance Standards for Mobile Communication Devices." In: *Mobile Antenna Systems Handbook*, K. Fujimoto (ed.), Artech House, Inc (2008)

Osepchuk, J. M. and Petersen, R. C. "Safety and Environmental Issues," In: *The RF and Microwave Handbook*, M. Golio and J. Golio (eds.), CRC Press LLC, Boca Raton, FL, pp. 21-1 – 21-21, 2008

B. Testimony at Trial or Deposition in Previous Four Years

Hearing testimony—CAAM Partnership LLC, Application for Major Modification of Conditional Use Permit to Add Two AM Radio Antenna Structures, File No. 07-109195 LV, Snohomish County, Washington Hearing Examiner.

C. Compensation

My current professional fees for research, document preparation and testimony is $200.00 per hour plus expenses.

D. Exhibits

I may refer to various exhibits or summary material to illustrate my opinions. Some of the types of materials that I may refer to include figures, tables, graphs, and quotations from reports on which I rely.

Dated: January 4, 2011

Ronald C. Petersen