



# Non-Ionizing Radiation Updates

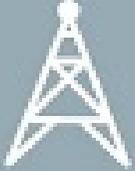
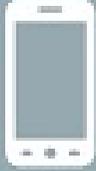
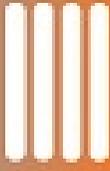
Bob Johnson

**EME**  
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# What is NIR?

- Non-ionizing (or non-ionising) radiation refers to any type of electromagnetic radiation that does not carry enough energy per quantum (photon energy) to ionize atoms or molecules—that is, to completely remove an electron from an atom or molecule.
- A physical, rather than chemical, hazard. Physical hazards include ergonomic hazards, radiation, heat and cold stress, vibration hazards, and noise hazards.
- NIR is Electro-magnetic radiation that spans from DC fields to Ultraviolet radiation, including visible light.

# A Look at the EM Spectrum

MRI	Electricity	AM/FM	TV	Mobile/ Cellular	Satellite	Heat lamp	Day light	Tanning	Medical	Nuclear
U										
Static	Power frequency	Radiofrequency (RF) and microwave				Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

Non-ionising electromagnetic fields				Optical radiation		Ionizing radiation	
induced currents		heating		surface heat	photochemical effects	broken chemical bonds	



# Significant ELF Sources

- **Power-frequency fields** – electric and magnetic fields associated with the generation, transmission, distribution and use of electricity: 60 Hz in U.S. & small part of Japan; 50 Hz elsewhere. Currents of 100 Amps or more can create fields that exceed implanted medical device limits (100  $\mu$ T).
- **Degaussing** – ELF magnetic fields may be used to demagnetize material: used for magnetizable media (e.g. storage tapes), computer screens, airplanes, and naval vessels.
- **Welding** – Electric arc and resistance welding.
- **Furnaces** – Electric furnaces (ladle, arc, induction, and channel) used for hardening, smelting, and heat-treating conductive materials.

# Significant RF/microwave Sources

- **Dielectric heaters** – operate at 10 – 100 MHz (many at 27 MHz) to heat dielectric materials (e.g., plastics) to cure, bake, mold seal, or emboss; unshielded units may produce overexposures. Units operate at kW power levels.
- **Semiconductor manufacturing tools** – sputterers, plasma etchers (13.56 MHz)
- **Induction heaters** – operate at < 500 kHz to harden, weld, forge, found, solder, anneal, or temper conductive materials.
- **Broadcasting** – AM radio (535-1605 kHz), FM radio (88 – 108 MHz), VHF TV (54-88 MHz, 174-216 MHz) and UHF TV (470-692 MHz)
- **Rooftops** – Fixed systems (satellite, microwave relay), Base stations (cellular, wireless) greater than 5 Watts
- **Radar** – pulsed microwave emissions; commercial, military, marine & traffic control radars. Most in SHF spectral region.
- **Diathermy** – Shortwave (13 & 27 MHz) & microwave (915 & 2450 MHz) used to heat tissues: both pulsed and CW mode.

# Effects vs. RF Frequencies

<p>Body is transparent to the H field, no absorption of E fields, other than contact current</p>	<p>E and H start to get absorbed, induced currents generated as well</p>	<p>E fields absorbed more than H field, currents reach maximum at resonance. SAR is basic dosimetric quantity. Highest absorption and penetration at resonance. Penetration decreases with higher frequencies</p>	<p>Surface heating, decreasing depth with higher frequencies</p>
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DC

3 kHz

100 kHz

100 MHz

6 GHz

# Literature Review

- Electro-sensitivity has not been proven in any peer-reviewed science.
- Latest interests looking at total temperature of tissues, not just from RF.
- More interest in lower frequencies and the differences in limits from the major standards organizations.
- “Collectively, none of the epidemiologic papers discussed in Occupational or Environmental Exposures and Cancer provide credible, statistically significant findings that chronic exposure to RFEMF emitted by various sources can initiate or promote any form of cancer in humans. This conclusion is also applicable to the studies in Mobile Phones and Cancer on prolonged use of mobile phones and particularly of personal communication devices, such as analog, digital, and cord-less telephones held to the ear during use, and the occurrence of malignant or benign tumors in the human brain.” Heynick *et al*, *Bioelectromagnetics Supplement 6:S74^S100* (2003).

# Major RF Standards and Guidance's

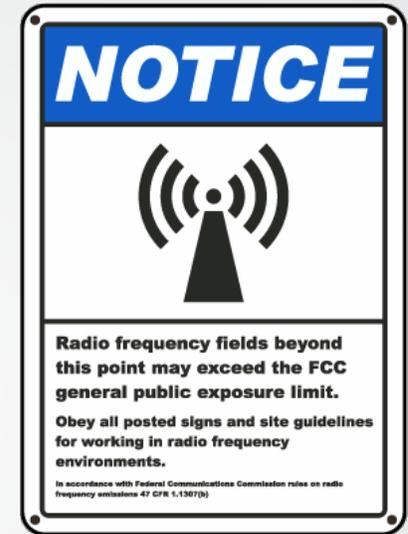
- Canada's Safety Code 6 (2015)
- FCC (1997)
- ICNIRP (2010)
- IEEE C95.1-2018 (ACGIH will most likely be similar)
- NATO C95.1-2345-2014

# OSHA 1910.97

- There are no Occupational Safety and Health Administration (OSHA) regulations for any of the fields of radiation, in effect.
- The 1975 Swimline decision by the Occupational Safety and Health Review Commission voided OSHA's original (1910.97) nonionizing radiation standard. "Radiation level which should not be exceeded without careful consideration of the reasons for doing so" (1910.97 (a)(iii)) is advisory language.
- However, the 1987 *United Auto Workers (UAW) and Brock vs. General Dynamics Land Systems Division* decisions allowed OSHA to enforce consensus standards through the General Duty Clause of the Act when there is no standard for a specific hazard. LOTO is normally used for enforcement when required.



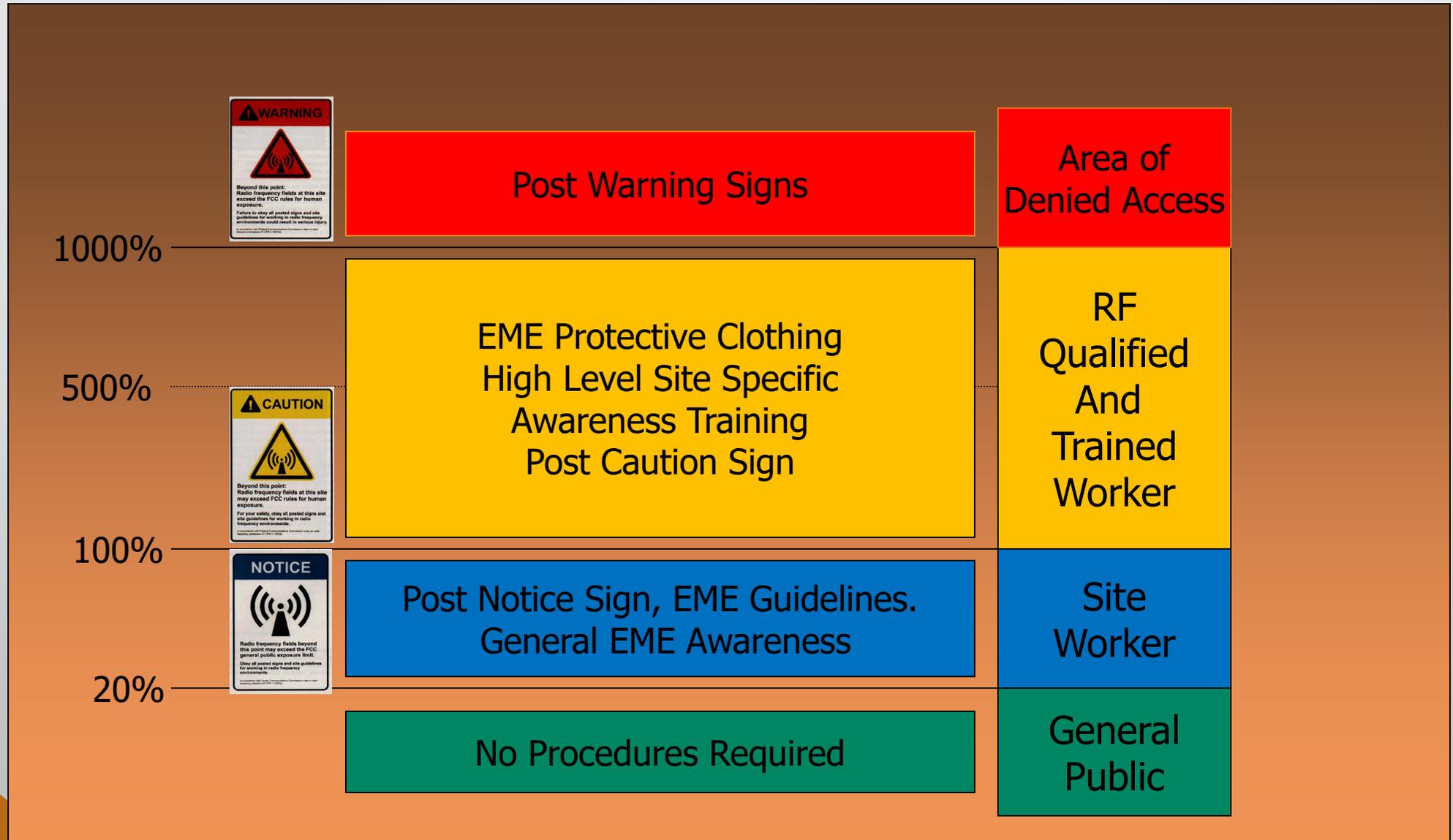
# Signage



- Signs and Symbols that follow IEEE C95.2 and ANSI Z535.
- Should be site specific, according to OSHA.
- Wording is up to you, but it should be active rather than passive.



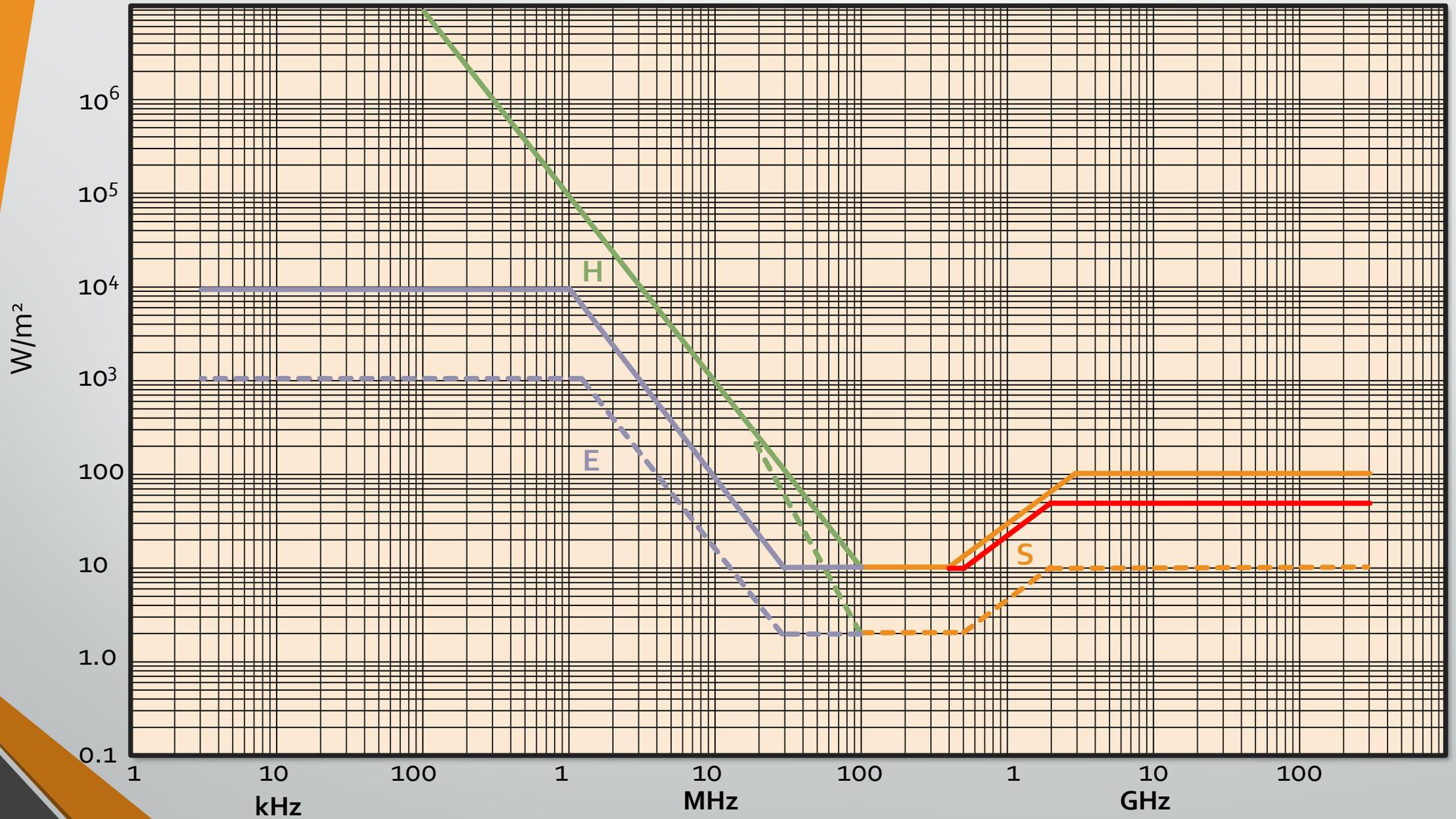
# EME Action Thresholds



# IEEE C95.1-2018 (Proposed)

- Major Changes Include:
  - Definitions (Unrestricted and Restricted)
  - Field Limits move closer to those of ICNIRP
  - Spatial Averaging volume only 4 cm<sup>2</sup> above 6 GHz
  - Covering from 1 Hz to 300 GHz
  - W/m<sup>2</sup> units as well as field strength
- Voted on and approved, expect release this year. This will affect ACGIH TLV's

# IEEE C95.1-2005 (and 2018)



# New RF Sources 5G

- 5G or 5<sup>th</sup> generation Cellular. Seems more about competing with cable companies. Speeds can be 300 MBs to 1 GBs for fixed receivers with modest increases for mobile users.
- Municipalities need to now have an RF Safety program for their workers who work around poles at elevated heights.



# Congress weighs in on Rooftops

- “Rooftop and building mounted antenna sites also endanger not only the wireless industry’s trained RF technicians but also roofers, water proofers, electricians, carpenters, building maintenance personnel, HVAC technicians, painters, firefighters, and other workers who may come in close proximity and be placed at risk of RF injuries.”
- “We look forward to hearing what next steps you have planned to make sure that the expansion of our telecommunications infrastructure does not come at the expense of the health and safety of hardworking Americans. Thank you for your attention to this very important occupational health and safety matter.”

Letter to FCC from Sen. Blumenthal, Rep. Eshoo – September 17, 2015

# New RF Sources



- Ossia (Italian for alternatively) has introduced microwave sources for charging devices.
- Think of a store that can power displays and change prices remotely, or target a display for you?

# Future of RF Surveys

- FCC getting pushback about 5G rulings from Cities. FCC needs to release new rules, but will they?
- There is a growing number of government and industrial entities that are calling for independent certification of RF Safety Officers to meet the rapidly expanding uses of NIR energy's.
- Expect certification in the US, much like what exists in other countries already.
- Equipment needs to be calibrated in an Accredited facility in order to be recognized.

# Questions?

- References

- IEEE C95 Standards - <http://ieeexplore.ieee.org/browse/standards/get-program/page/>
- ICNIRP – [www.icnirp.org](http://www.icnirp.org)
- FCC - <https://www.fcc.gov/general/radio-frequency-safety-o#block-menu-block-4>

- Contact Us

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- Thank you for Attending!

