Radio Frequency (RF) & Other Non-Ionizing Radiation Hazards

Matt Butcher
Sublight Engineering
Rich Biby
Two Hops Wireless

We will be starting at 12:00 Noon EDT
Please mute yourself upon entry

Cyber Chapter Purpose

- The Cyber Chapter offers a convenient alternative to traditional Chapter membership, with the same networking and continuing education options available, in an easily accessible on-line format.

- Cyber Chapter membership provides a broader national perspective on issues facing CHMMs and EHS&S professionals.

- The Cyber Chapter also provides the opportunity to network with professionals from many different locations and disciplines.

Cyber Chapter Mission

The Cyber Chapter is committed to providing its members with the most up-to-date information on sustainability, alternative energy, and improvement of environmental practices as they relate to hazardous materials management.

Business Items

www.ahmpcyber.org

- Membership is $35/year
- CC will partner with your organization/chapter on your courses and your regular meetings
- Recording of all approved presentation will be available in the Cyber Chapter Library for members. Many recordings are open to all.

AHMP Cyber Chapter Board Members

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Calendar

AHMP Cyber Chapter Board meetings are the first Monday of each month at 4:00 PM Eastern. Click here to register.

Next on the calendar:

May 11-12, 2021, Mid-Atlantic Construction Safety Conference

Register Now This two day conference is hosted by two partners of the Cyber Chapter; ASSP-NOVA and WMACSA. The OSHA Director of Construction is just one of several expert speakers.

~~May 10-12, 2021, Essentials of Hazardous Materials Management (EHMM) Course - Joint Meeting with the Rocky Mountain Chapter of AHMP, 10:00 AM - 6:00 PM (daily) Eastern (all-day)~~ - Postponed

Register Now

In association with the Rocky Mountain Chapter, a virtual EHMM course will be conducted.

May 11, 2021, Biosafety, Biosecurity, and Epidemiological Surveillance - Joint Meeting with ChABSA - 6:30 PM Eastern

Register Now In association with the Chesapeake Area Biological Safety Association

Ochoa Carrera will discuss leasons learned, current challenges and perspectives after COVID-19 pandemic. In this session we will discuss the relation between the epidemiological surveillance and biosafety and biosecurity measures that guided Mexico to mitigate the effect of infectious diseases during the past years. In addition, this session will be used to show how are we dealing with emerging infectious diseases and how are we preparing for the next epidemic.

May 20, 2021, Viginia Occupational Safety and Health (VOSH) Upate - Joint Meeting with the ASSP NOVA - 12:00 PM Eastern Free

Register Now This is the NOVA chapter annual update on what has happened in the past year and plans for the next.

June 7, 2021, ChABSA Pre-Symposium Workshop Day 1 - Joint Meeting with the ChABSA- 8:00 AM - 5:00 PM Eastern

Register Now Save the date for ChABSA's annual event.

June 8, 2021, ChABSA Pre-Symposium Workshop Day 2 - Joint Meeting with the ChABSA- 8:00 AM - 5:00 PM Eastern

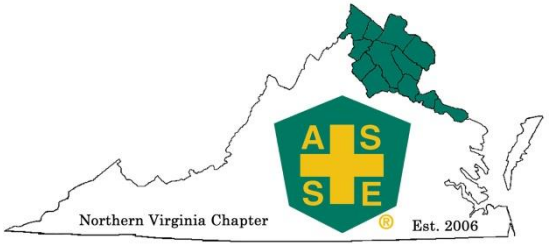
Register Now Save the date for ChABSA's annual event.

June 9, 2021, ChABSA Scientific Symposium - Joint Meeting with the ChABSA- 8:00 AM - 5:00 PM Eastern

Register Now Save the date for ChABSA's annual event.

AHMP C2 CyberChapter
Connecting Hazardous Materials Professionals Worldwide

ASSP NOVA Board



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The Mid Atlantic Construction Safety Conference

MACSC

Northern Virginia Chapter ASSP Est. 2006

(The Mid-Atlantic Construction Safety Conference)

- May 11 -12, 2021 07:00 – 2:00 EDT – All Virtual
- $99 register at www.macsc.net
- Hosted by:

Washington Metropolitan Area Construction Safety Association

Northern Virginia Chapter ASSP Est. 2006

American Society of Safety Professionals National Capital Chapter

Chesapeake Region Safety Council

American Subcontractors Association Metro Washington

ABC Virginia Associated Builders and Contractors

Draft schedule for MACSC 2021*

The Mid Atlantic Construction Safety Conference

Time	Tuesday 5/11/21	Wednesday 5/12/21
7:00 – 7:15	Introductory Comments	Introductory Comments
Session 1 7:15 – 8:15	Real Time Silica Monitoring Corey Bender and Frank Trujillo	Regulatory Update OSHA Directorate of Construction
Session 2 8:25 – 9:25	Mental Health and Substance Abuse in Construction Greg Sizemore ABC National	Falls -Finding solutions when working on existing buildings or limited anchor points are available
Session 3 9:35 – 10:35	COVID Standards – State Standards and practical concerns Bruce Donato K&A First Aid and Safety	Telemedicine Dr. Sean Duffy Concentra
Session 4 10:45 – 11:45	COVID Panel – Best Practices Brian Rizzo, Hourigan Frank Trujillo, Miller-Long	Cannabis in the Workplace – A Practical Study Dave Madaras Chesapeake Region Safety Council
Session 5 11:55 – 12:55	Session 5 11:55 – 12:55 Artificial Intelligence in Dash Cams	Session 5 11:55 – 12:55 ANSI Standards and Construction
Closing 12:55 – 1:10	Closing	Closing

*Speakers, topics, and times subject to change.

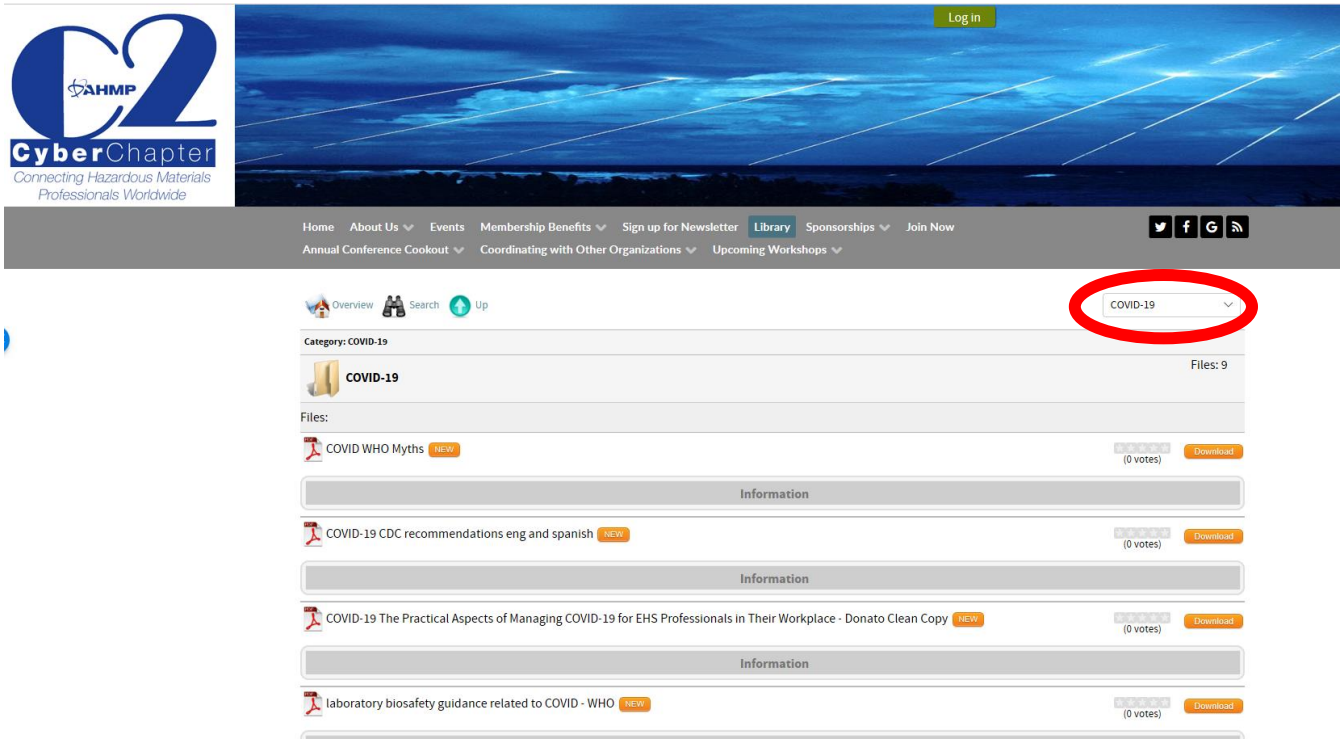
MACSC 2021 nor its seed organizations endorse any content provided nor confirm it accuracy.

Continuing Education

- The Cyber Chapter offers a free service to anyone who registers on the website to track attendance at events and allows participants to download a transcript.
- Transcripts are updated at least quarterly.

Slide Deck & Recording

- Go to www.ahmpcyber.org
- Library Tab, drop down menu e.g. “ASSP”



Ground Rules/ Webinar Directions

- All attendees will be unmuted. During the presentation please stay muted. Unmute when you have a question to ask.
- Questions can also be posed using the "question/chat" function in your dashboard and the facilitator will submit as appropriate.
- The following slides will provide more details on how to use the system.

RF Exposure

AMERICAN SOCIETY OF SAFETY PROFESSIONALS

What are all those antennas anyway?

Radio Frequency Exposure (RFE)

Complicated but rarely harmful

- As more antennas are built on towers, building and utility poles, confusion grows on worker safety.
- What are the risks, what do those signs mean, and how do you communicate about RF?

Matt Butcher

- Electrical Engineer
- Radio Frequency
- Human Exposure to RF
- Assessment / Mitigation
- Communications / Training
- IEEE / IEC / AFCCE participation
- PE – multiple states
- Canoeist / Traveler / Ham

Overview

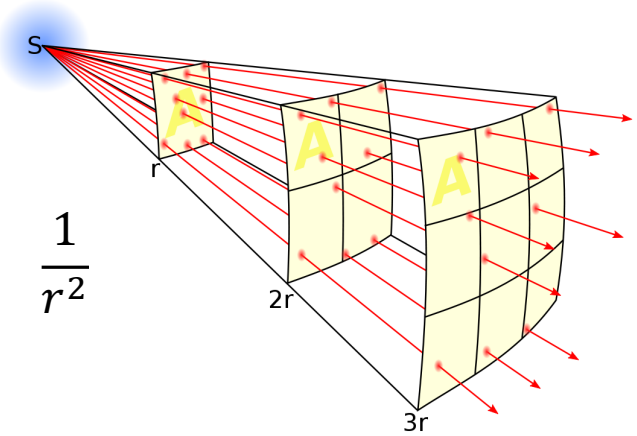
- What is Radio Frequency?
- Regulations and Standards
- Training for Occupational Exposure
- Antennas and Examples
- Risks
- Communications
- Questions

Terminology

- **EME** – Electro-Magnetic Energy/Emissions/Exposure
- **NIR/NIER** – Non-Ionizing (Electromagnetic) Radiation
- **RFR** – Radio Frequency Radiation
- **Emissions** – RF energy emitted or transmitted
- **RFE** – Radio Frequency Exposure

What / Where / How

- Wireless / Radio – signals that travel through space like light
- Part of the Electro Magnetic spectrum that includes radio waves, microwaves, infrared, light, ultraviolet, X-rays and gamma rays
- Power diminishes with distance – every doubling of distance reduces the power by a factor of four



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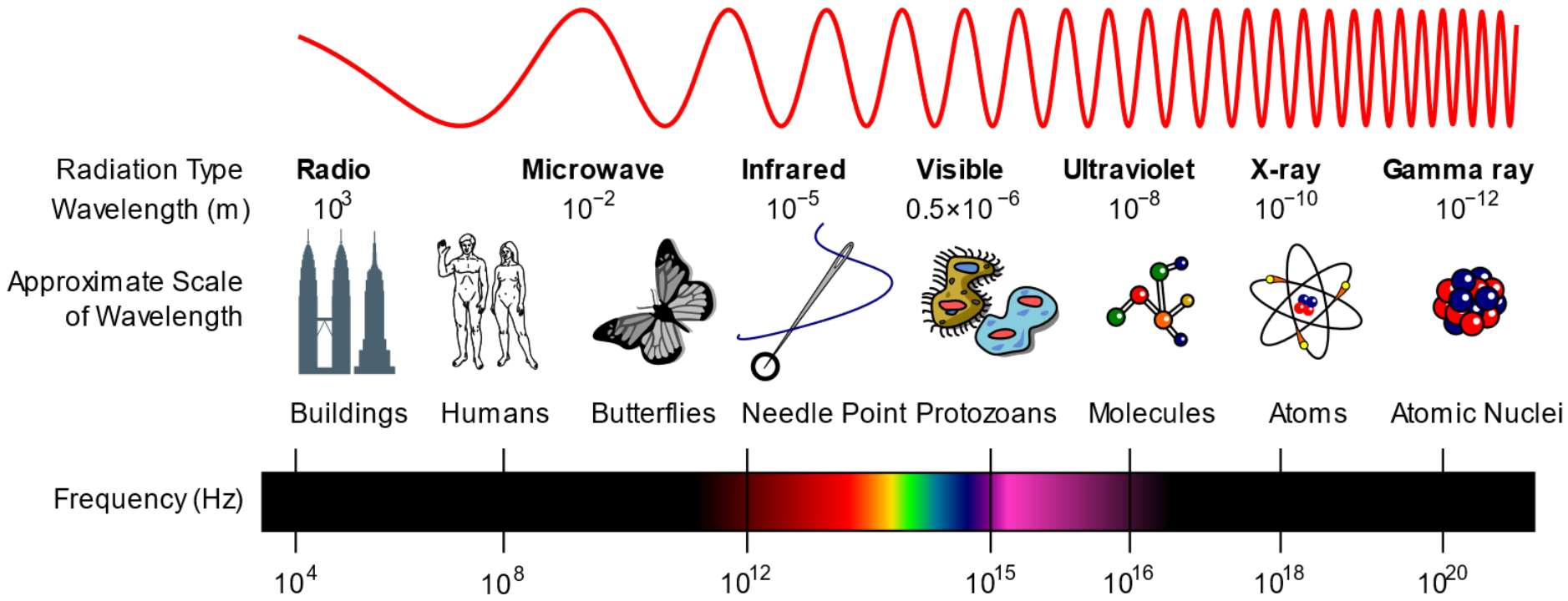
Electromagnetic Spectrum



Source: NASA
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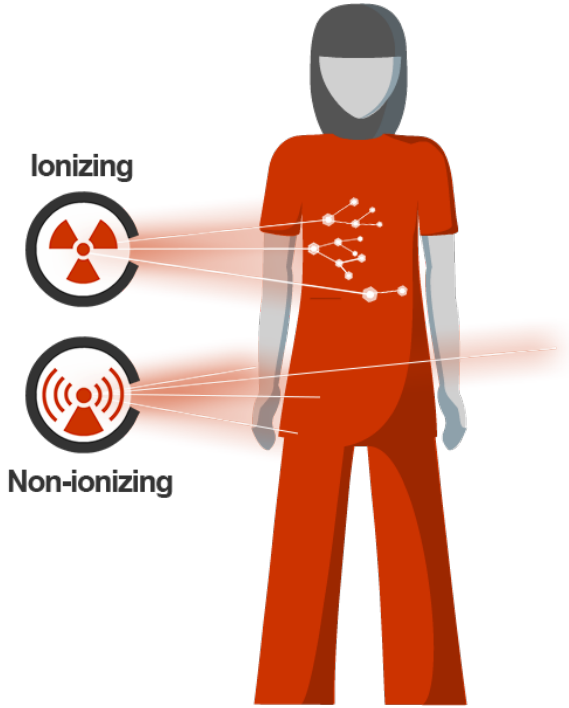
Ionizing vs Non

Ionizing radiation is high energy
Each particle or wave can have enough energy to change the structure of living cells in your body.

Non-ionizing radiation is low energy
Each particle or wave generally does not have enough energy to change the structure of living cells in your body.

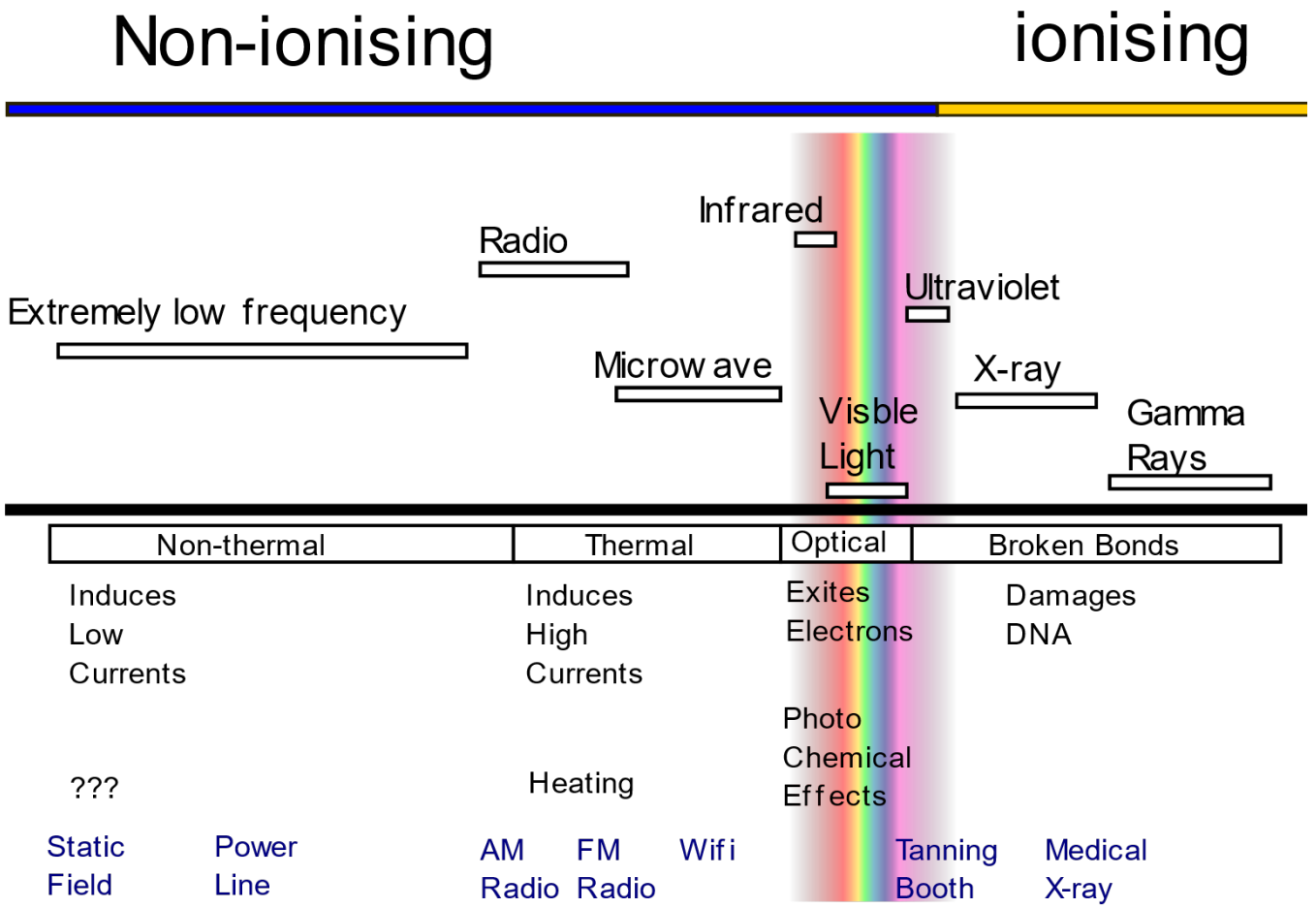


Cumulative Effects
Mutations of cells
Cancer
Heritable Disease

Acute Effects
Induced Currents
Heating
Burns

Source: Canadian Nuclear Safety Commission

Ionizing vs Non



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History of Research / Standards

- 1890 d'Arsonval noted that 10 kHz electricity could warm the skin
- 1928 discovered RF heating internal organs – diathermy
- 1953 US Navy established limit – heating from high power RADAR
- 1966 first ANSI / IEEE standard C95.1
- Revision Through 2020 include part / whole body SAR, Reference Levels, Occupational (10x) / Public (50x) Safety Factors
- Limits based on:
  - Partial / Whole Body Heating - Disruption of food motivated learning in animals - 1° C Temperature Rise
  - Electrostimulation – induced / conducted currents – pain threshold
  - Review of All Research – Including thousands of papers on Mobile Telephony

Regulations and Standards

- Congress Mandated - NEPA
- Input From Everyone - especially

- Similar To
- Recommended By

Federal Communications Commission

EPA

OSHA

National Institutes of Health

FDA

ICNIRP
INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION

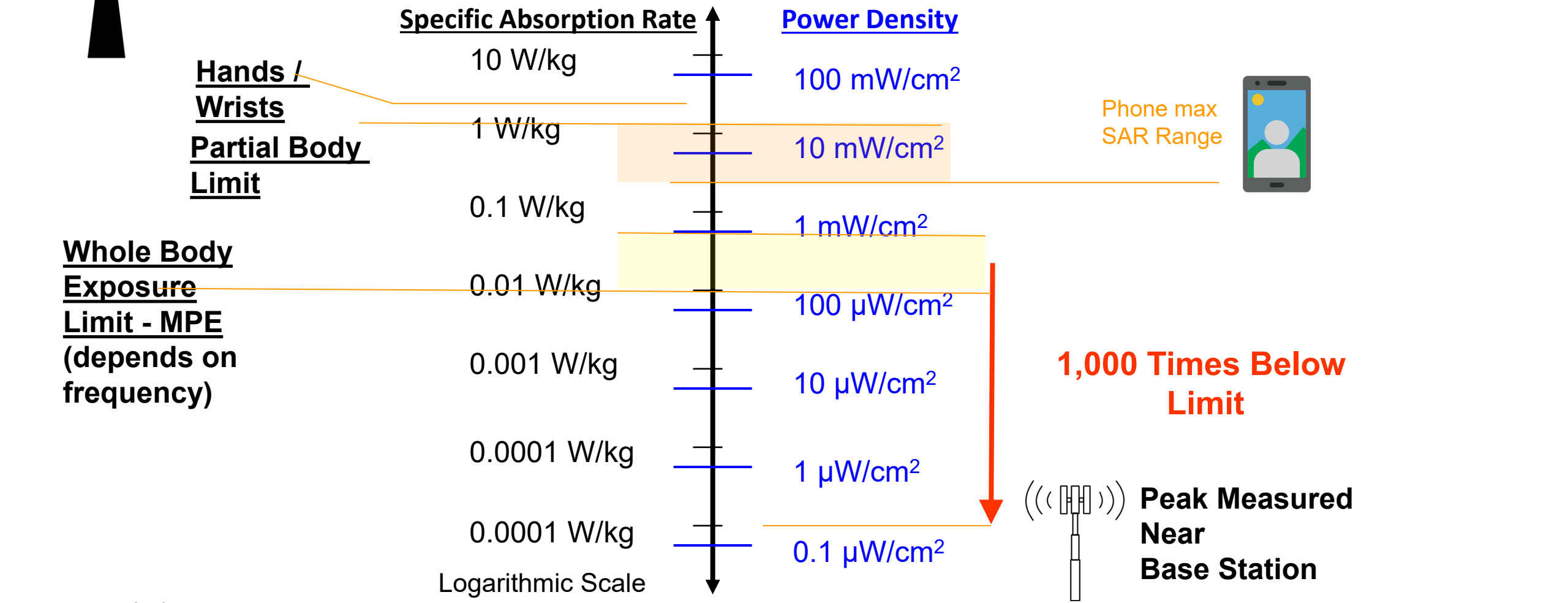
World Health Organization

IEEE

Regulations – FCC & OSHA

- FCC - 47CFR §1.1310
  - Exposure limits based on 1990s' NCRP / ANSI / IEEE recommendations
  - Similar to current IEEE / ICNIRP
  - Rules Updated Effective May 2021
- OSHA – General Duty Clause
  - Employer – shall furnish a safe workplace
  - Employee – has a right to know about hazards and shall comply with safety standards

RF Exposure Limits



FCC Exposure Limits – Two Levels

- **Occupational or Controlled Limits** 10 times safety factor below known biological effects
- **General Public or Uncontrolled Limits** are 5 times *additionally* lower (total of 50 times safety factor)

- Who is Occupational? Personnel who, through training and signage, ***are aware of and can control their exposure***

- Limits Based on Spatial & Time Averaging – whole body exposure over time – 6 minutes for Occupational, 30 minutes for the General Public
- Partial Body (hands, head, etc.) exposure limits are higher

Safety Factor Analogy

- Large Margin of Safety
- Even more for the General Public

% of Limit		Imaginary Microwave Setting	
Occ	GP		
10,000%	50,000%	P100	Hot!!!
1,000%	5,000%	P10	Observed Biological Effects
100%	500%	P10/10 (P01)	Occupational Limit
20%	100%	P10/50 (P00.2)	General Public Limit

OK… but what does it mean?

- RF exposure ***at very high levels*** can be dangerous
- Knowing ***where it is safe to work*** will ensure safety
- If you have to work where exposure may or does exceed limits, take appropriate action
- Safety Concern – transmitter sites where workers must work close to antennas
- Relative Risk Low (versus Fall, High Voltage, etc.)
- Medical Implants – use the General Public limit unless approved by physician

RF Awareness Training

Training provided to make someone qualified to work in areas that exceed the General Public exposure limits. The goal of training is to allow a worker to "be aware of and control their exposure."

RF Basics | Regulations | How to Work Safely

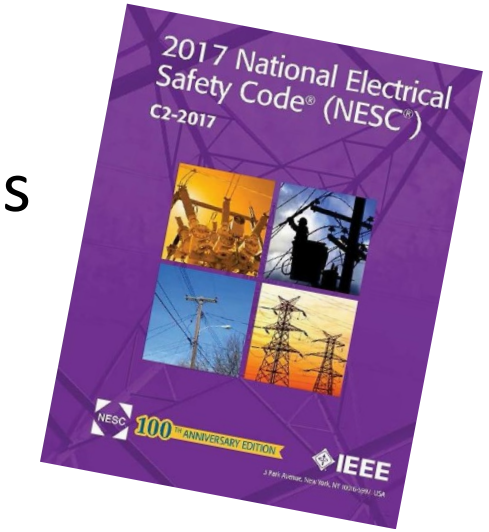
- Specific training for an installation or type of installations (DAS)
- General education for working at (most) RF installations
- Expanded training for managers, safety officers, designers

A trained worker may work in areas that exceed the General Public Limit… All Day

NESC 410A6

RF Exposure Training

The 2017 NESC has added Rule 410A6 requiring employers to provide training to employees who work in the vicinity of antennas operating in the cellular range (3 kHz-300 GHz) in order to mitigate radio-frequency energy. Rule 420Q requires employees to apply training and methods to mitigate potential overexposure to radio-frequency energy.



https://incident-prevention.com/ip-articles/new-updates-to-the-national-electrical-safety-code

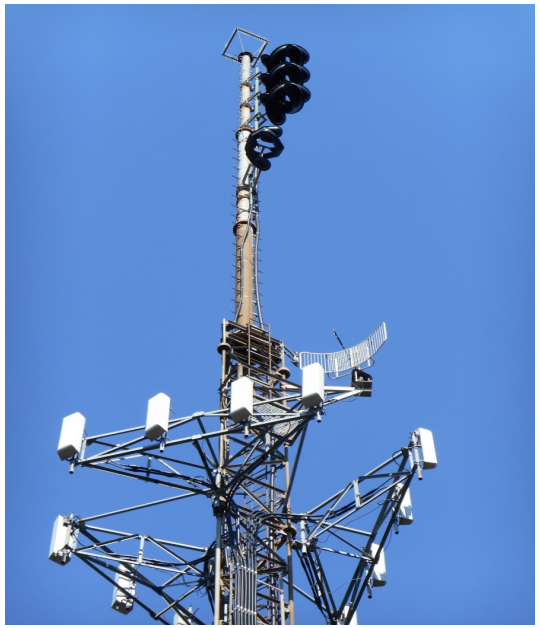
RF Safety Plan

This often doesn't exist!

So…

- Read and Interpret Signs
- Recognize Antennas
- Request RF Assessment
- Call the number on the signs

Broadcast Antennas



FM and Cell Antennas

VHF Antenna

UHF Antennas

Wireless Antennas

Barriers indicate areas where limits may be exceeded

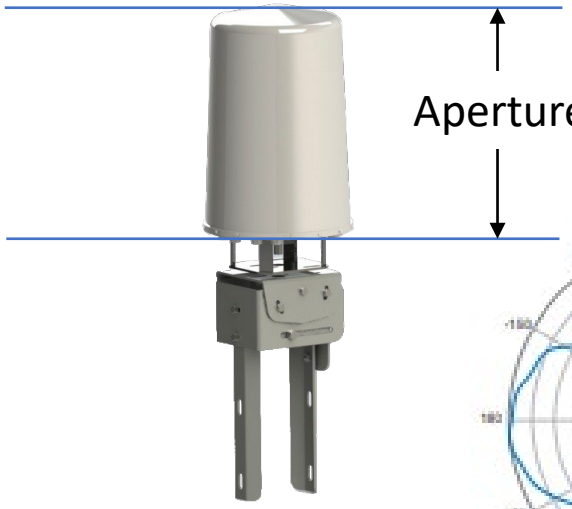
Other

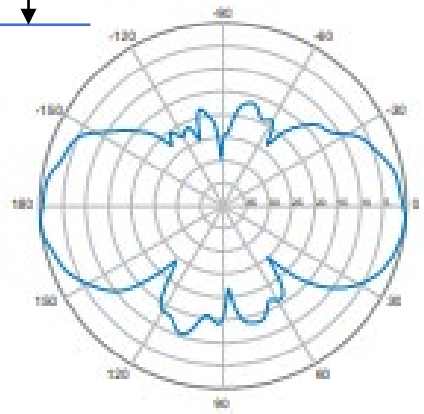
Land Mobile Antennas - Low Duty Cycle, Check!

Microwave dishes - generally low transmit power

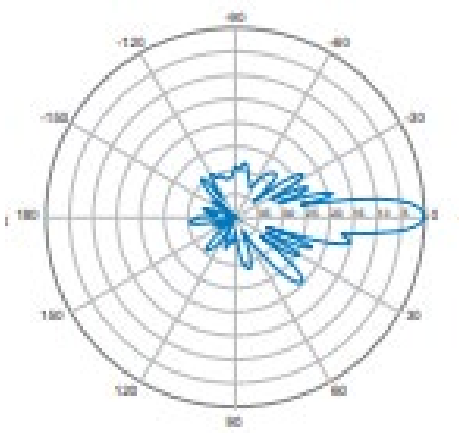
Antenna Aperture

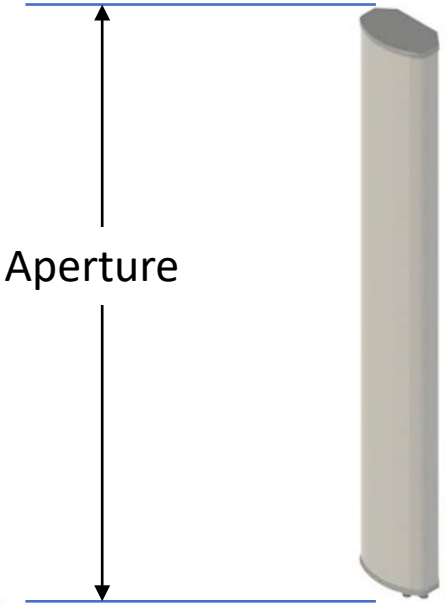
The working part of the antenna, where the majority of the RF is concentrated.





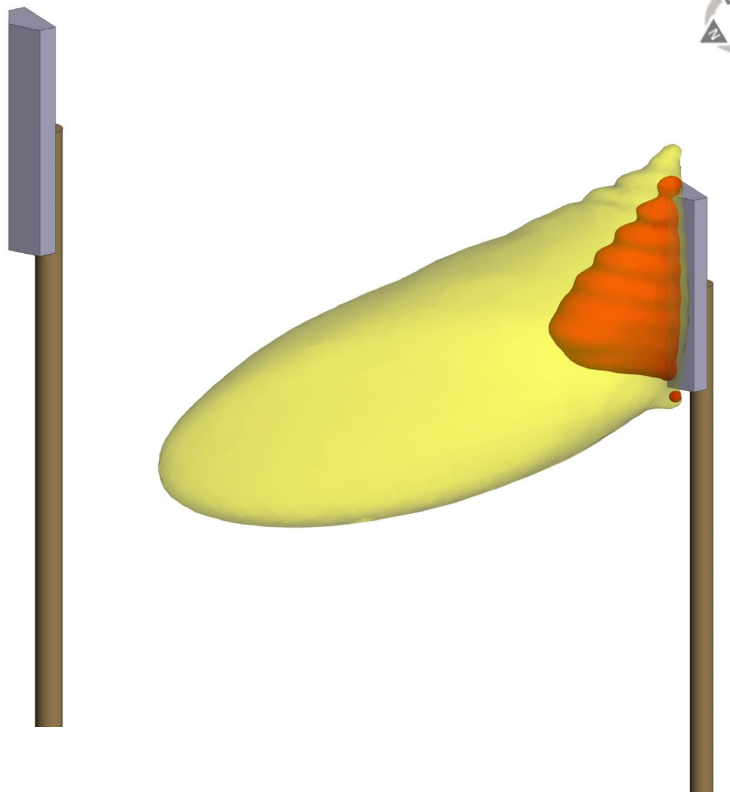
The longer the antenna, the “tighter” the pattern.





Panel Antenna

- Most common base station antenna
- Found on towers and rooftops
- Directs energy out from face
- Below and Behind – little RF



Where do you worry?

What kind of sites can cause over exposure?

Very Little

A lot more…

When Access is Required

When people, generally workers, get close to antennas

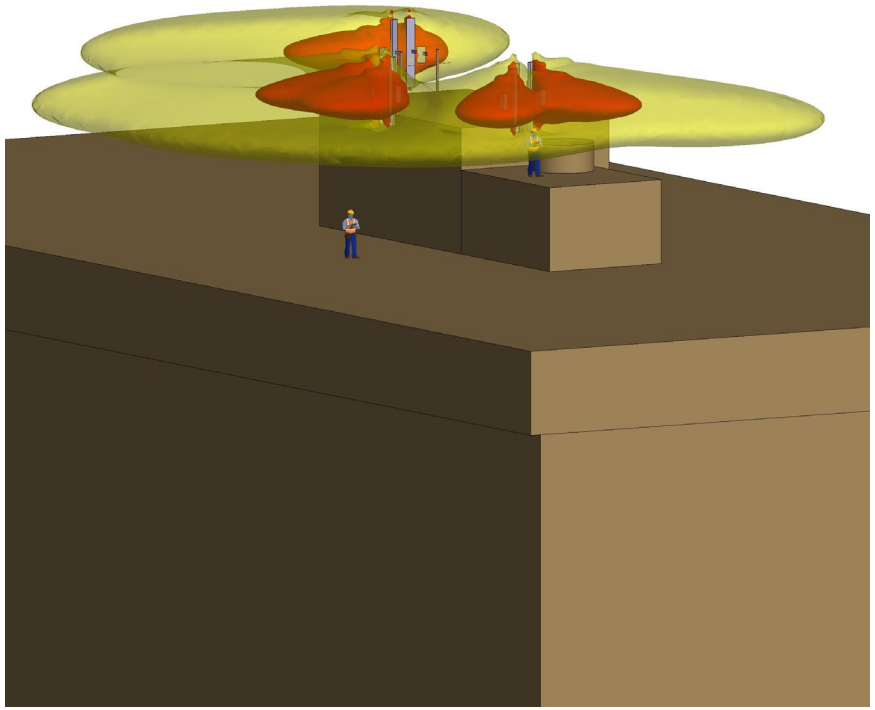
To Determine Compliance

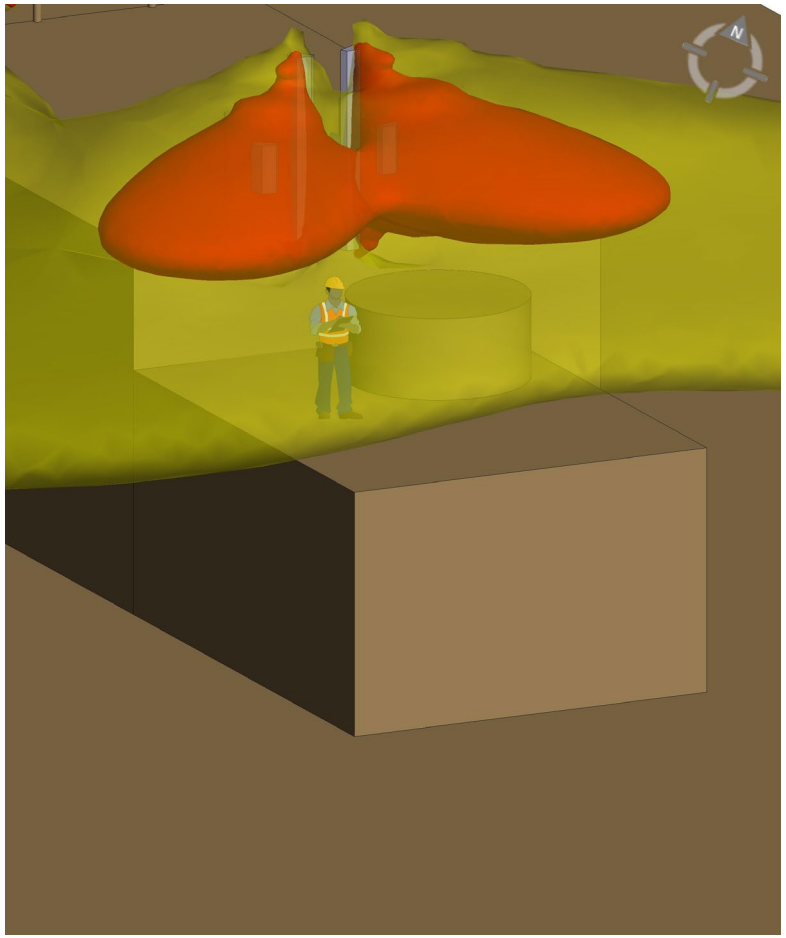
When there is a question on exposure

Where expectation of exposure is low

If there is no way to get in front of the antennas, there is no risk of over exposure

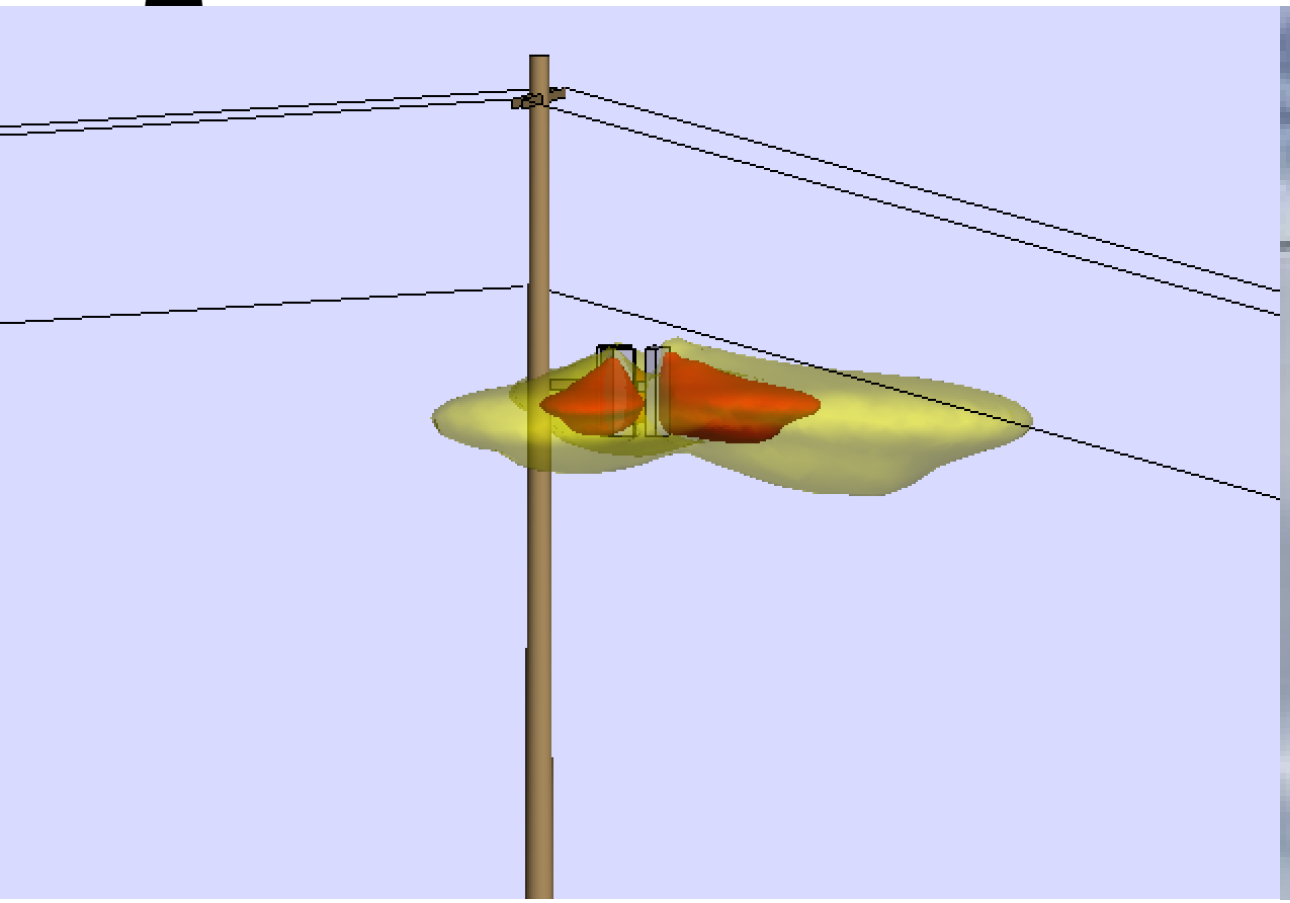
Rooftop Modeling





Areas of concern

Small Cells – Similar Areas of Concern



RF Alerting Signs

RF Exposure Signage has proliferated – often confusing and not-informative

"Sign, sign, everywhere a sign
Blockin' out the scenery, breakin' my mind
Do this, don't do that, can't you read the sign?"

Sign Rules

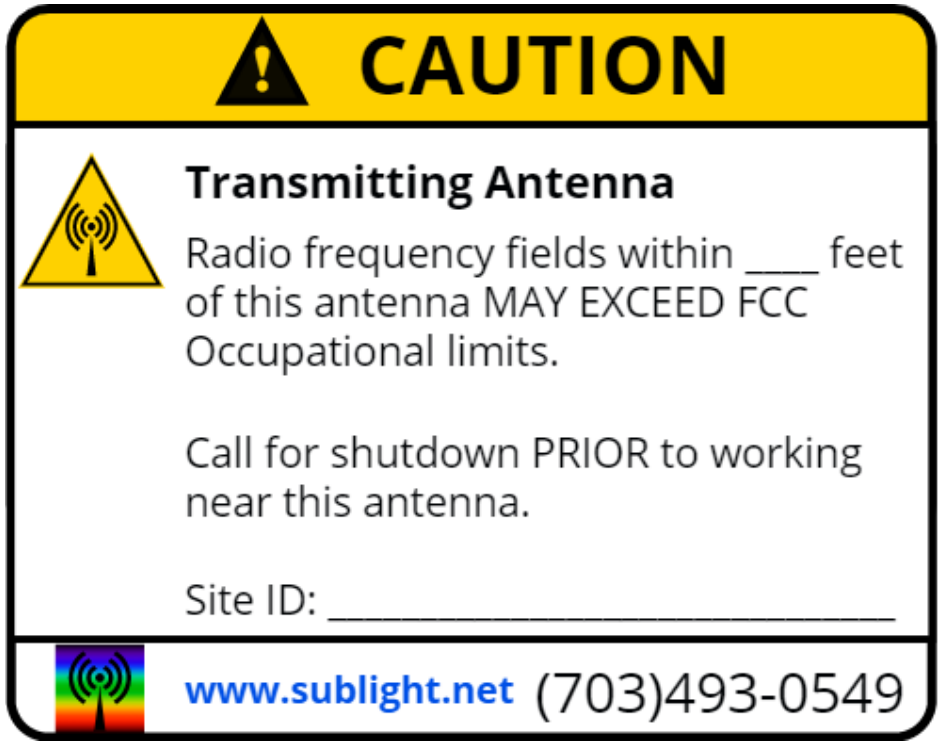
The FCC now requires sign details

RF Alerting Signs must:

- Include a description of the source (Transmitting Antenna)
- Provide behavior to prevent overexposure
- Have up-to-date contact information

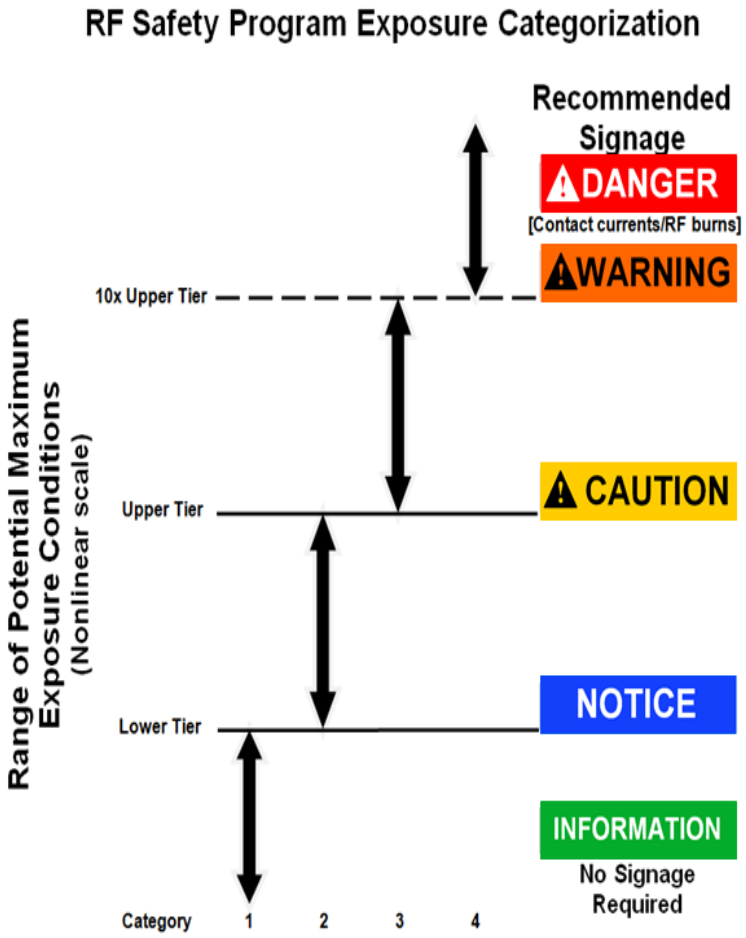
Signs mounted on antennas must:

- Indicate the approach distance
- Be readable at that distance



What is in a good sign?

- Signs should have the proper symbol and alerting words for the exposure conditions
- The text should be succinct and contain:
  - Description of the hazard
  - Instructions on how to avoid it
  - Site Identification & Contact Information



RF Alerting signs

Blue Notice Sign – indicates an area where exposures **may exceed General Public limits**. RF levels may be greater than the General Public limits, but they will be less than the limits for human exposure or the Occupational limits.

Work can safely be done in this area with no time restrictions or need for personal monitors or other controls. Workers should be aware of antenna locations and understand on rooftops that if they must work **above the walking surface** near antennas, additional precautions are required.

Yellow Caution Sign – indicates an area where RF levels **may exceed Occupational or human exposure limits**.

Workers should use personal monitors to determine if exposure in the identified area exceeds limits, paying close attention to areas immediately in front of antennas. Reduced power or turning off transmitters may be required to work in this area for more than a few minutes.

RF Alerting signs

Orange Warning Sign – This sign is used to indicate areas which **greatly exceed Occupational or human exposure limits** and immediate harm may result. Typically, these signs are placed on broadcast or other high-power installations.

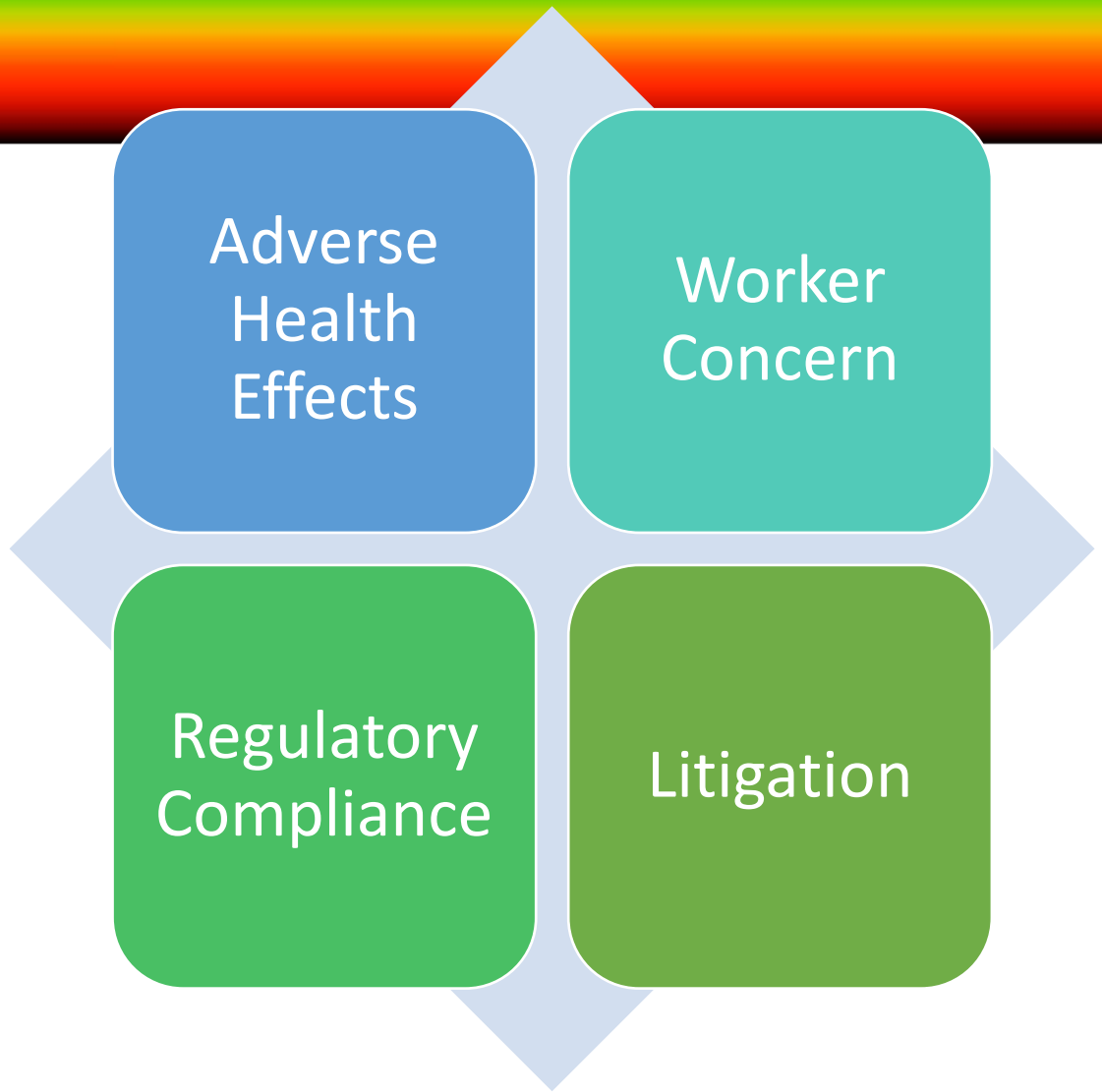
Working in areas with orange Warning signs must include coordination with the antenna owner, the power must either be reduced or turned off, and monitoring or lock-out-tag-out procedures must be employed.

RF Monitors

- What can you do with a Personal Monitor?
  - Determine if an antenna is on
  - Get a rough feel for exposure level
  - Validate an exposure assessment
- Narda
- FieldSense
- Wavecontrol
- SafeOne
- MVG

Only useful with RF Awareness Training!

Risks



Adverse Health Effects

The vast majority of RFR overexposures result in no symptoms at all. Because of the large safety margin in existing standards, most people suffer no harm and are not even aware that they were exposed in excess of the standard. In these situations it is not necessary that these individuals be seen by a physician. However, upon learning that they had been exposed, some people develop acute anxiety reactions and may require medical attention and continuing reassurance if appropriate.

Medical aspects of radiofrequency radiation overexposure – COMAR 2002

Possible Symptoms

- Shocks & Burns (superficial and deep)
- Auditory effects (click sounds)
- Sensation of warmth (localized or whole body)
- Nausea, vomiting, headache, dizziness, fatigue (CNS heating)
- Ocular effects (irritation, cataract)

Worker Concern

- Lots of disinformation out there…
- Other safety concerns have clear and understandable harm
- RF is:

  Something that cannot be seen, heard, smelled or touched

- RF is often confused with Ionizing Radiation and Harmful Environmental Pollutants which DO cause harm in small and / or accumulating doses.

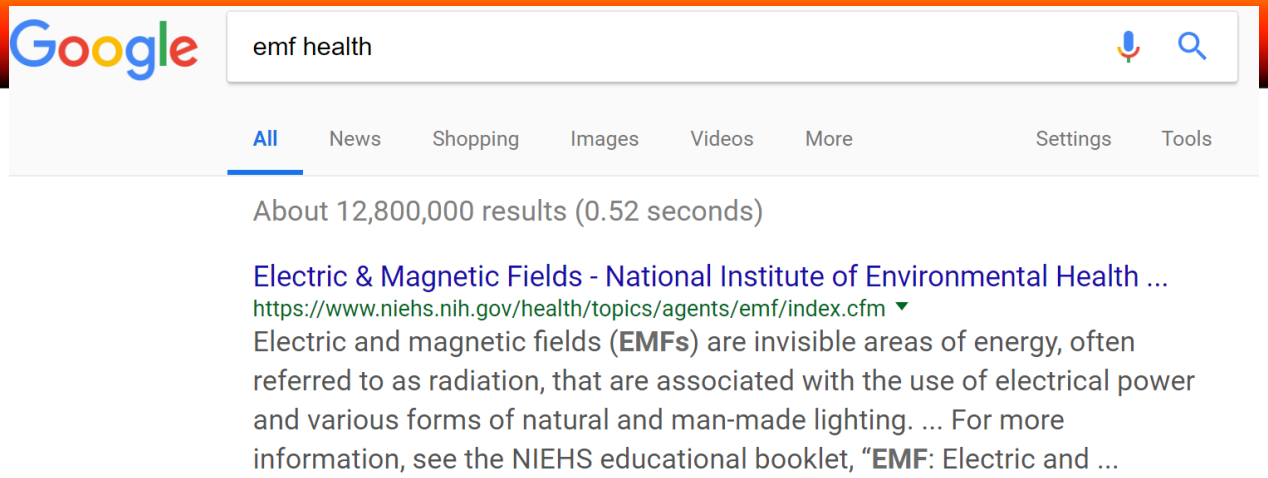
Regulatory / Litigation

- Rules from the FCC have been clarified
  - New guidance documents are in the works
- Litigation can be the result of insufficient training

Talking about RF Exposure

- There are Many Sources of Information
- …some better than others
- Provide clear information
- Reference respected sources
- “Risk = Hazard + Outrage” – Peter Sandman
- Confirmation Bias is real → Don’t try to convince activists

Google EMF Health



- WHO
- NIEHS
- CANCER.GOV
- BETTERHEALTH.VIC.GOV.AU
- WELLNESSMAMA.COM – Health advice that wanders
- SAFESPACEPROTECTION.COM – Gadgets that make everything OK

Source

BioInitiative 2012

Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

- Home
- Editors' Notes
- What's New?
- BioInitiative Report
- Research Summaries
- RF Color Charts

BioInitiative 2012

A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

Canadians are Worried

ABOUT C4ST LEARN MORE C4ST CANADIANS FOR SAFE TECHNOLOGY CANADIENS POUR UNE TECHNOLOGIE SÉCURITAIRE RESEARCH NEWS CONTACT US

Media Selling Clicks

Could Wearable Computers Be As Harmful As Cigarettes?

MARCH 18, 2015 NY Times

No…

Betteridge's law of headlines

"Any headline that ends in a question mark can be answered by the word *no*."

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Radio Frequency Safety

Radio Frequency Safety

FCC Policy on Human Exposure

RF Safety FAQ

Many consumer and industrial products make use of some form of electromagnetic energy. Because of its regulatory responsibilities in this area the Federal Communications Commission (FCC) often receives inquiries concerning the potential safety hazards of human exposure to radio-frequency (RF) energy. The information on this page provides answers and information to inquiries regarding RF Safety.

Cancer.gov

NIH NATIONAL CANCER INSTITUTE

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CAUSES AND PREVENTION

Risk Factors

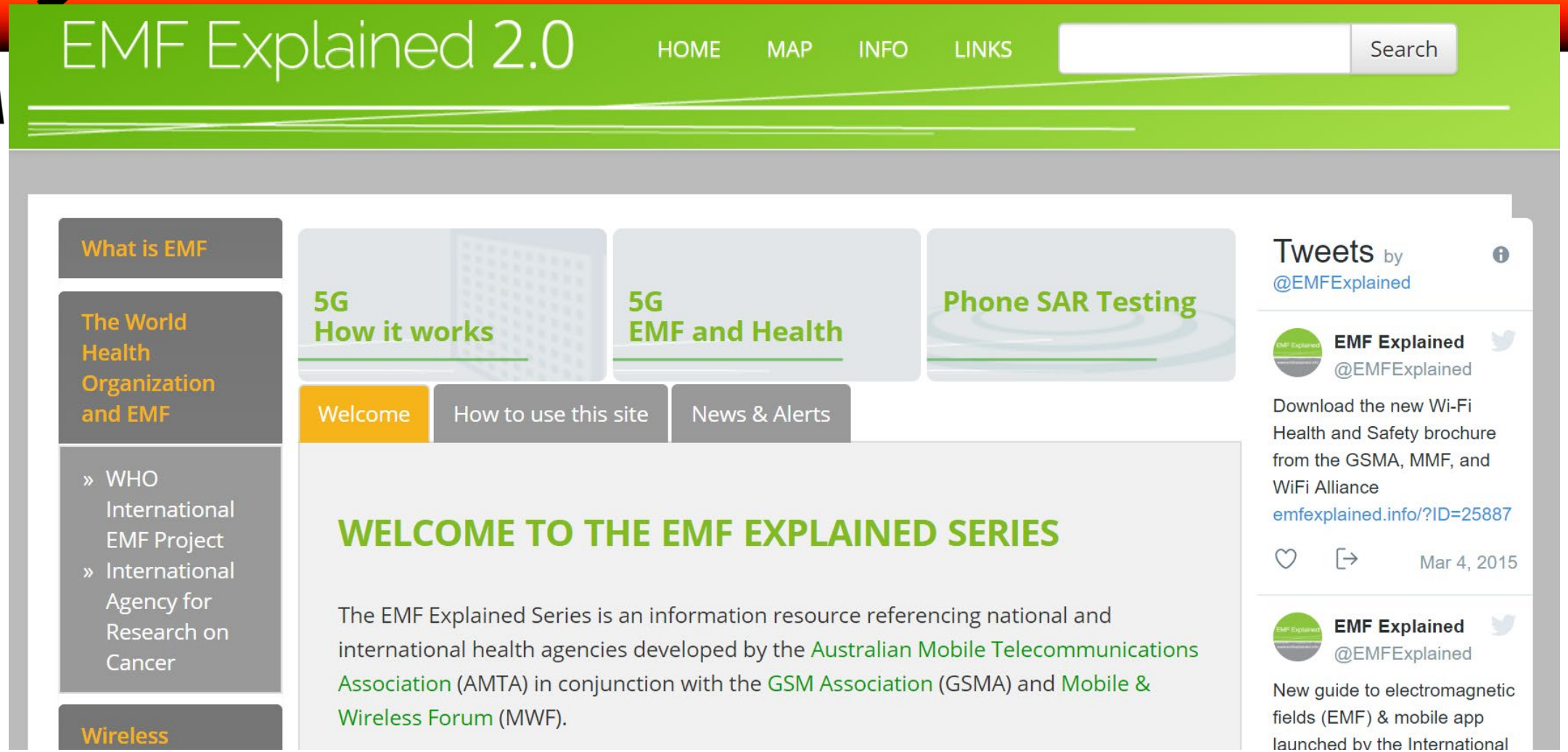
- Age
- Alcohol
- Cancer-Causing Substances
- Chronic Inflammation
- Common Cancer Myths and Misconceptions

Cell Phones and Cancer Risk

ON THIS PAGE

- Why is there concern that cell phones may cause cancer or other health problems?
- What is radiofrequency energy and how does it affect the body?
- How is radiofrequency energy exposure measured in epidemiologic studies?
- What has research shown about the possible cancer-causing effects of radiofrequency energy?

Industry Sponsored



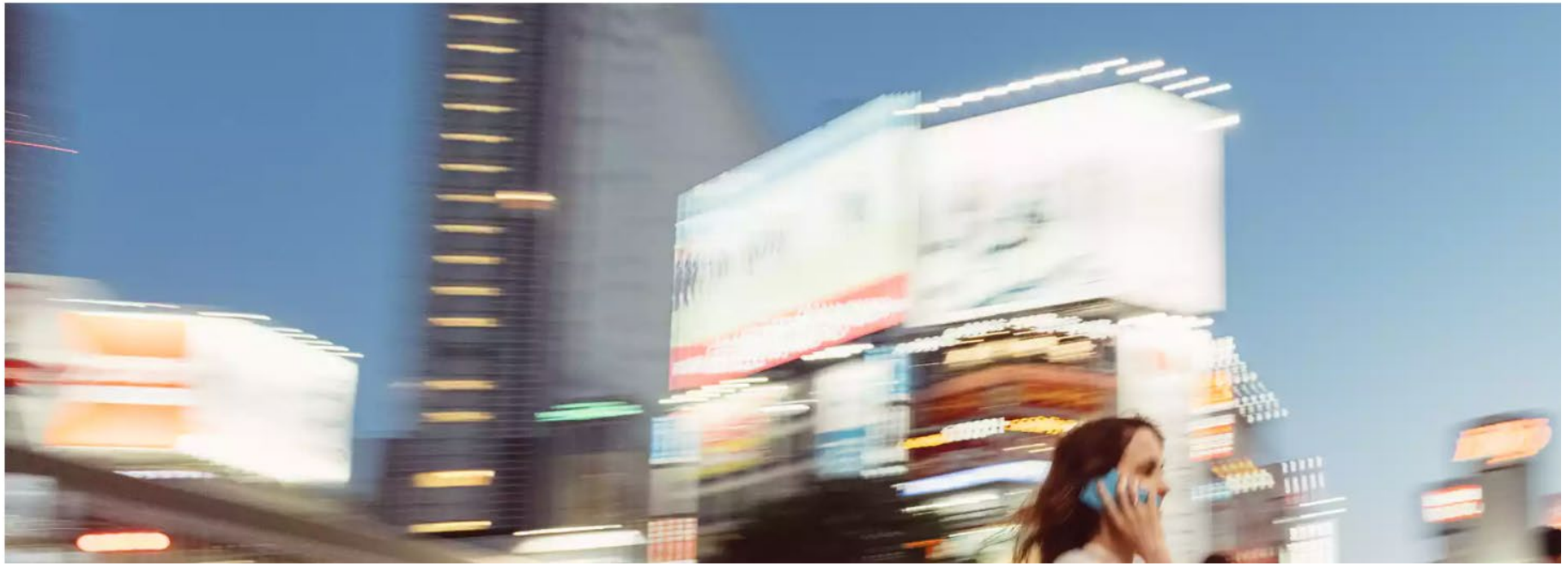
Conspiracy Debunker

The Observer
Mobile phones

Mobile phones and cancer – the full picture

David Robert Grimes

Sat 21 Jul 2018 12.00 EDT



Summary

- RF – concepts and exposure standards
- Safety Training – workers near antennas
- Risks – what may happen
- Communications – explaining RF

Questions

Thanks!

Matt Butcher

matt@sublight.net

www.sublight.net