



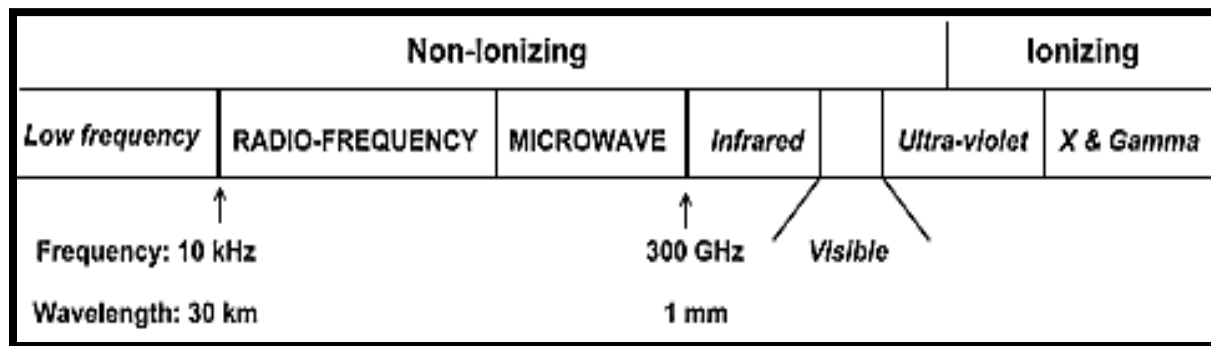
Boston University Radiofrequency Safety Training

For Charles River Campus and Medical
Center Campus

Why is training Needed?

- To inform and train workers to recognize potential areas of RF exposure
- BU RF Training Program
 - Work site safety mindset: Workers should be familiar with RF safety if exposures due to RF are possible.

Radiofrequency (RF) Radiation



- Radiofrequency (RF) Radiation” refers to the electromagnetic fields with frequencies between 300 kHz and 300 GHz, often extending the lower-frequency boundary of RF radiation to 10kHz, or even to 3 kHz in order to include emission from commonly used devices.
- RF radiation is produced by devices such as **radio and TV transmitters, Pager Antennas**, induction heaters, and dielectric heaters (also known as RF sealers).

Common Sources of RF radiation

Source	Frequency (MHz)	Potential for Over-exposure?
Video Display Terminal (VDT)	0.015 - 0.3	No
Dielectric Heater	1 - 100 (typically 27.12)	Yes
Communications Transmitters: AM Radio	0.535 - 1.605	Yes
Communications Transmitters: FM Radio	88 - 108	Yes
Communications Transmitters: VHF TV	54-72, 76-88, 174-216	Yes
Communications Transmitters: UHF Radio	470 - 890	Yes
Communications Transmitters: Dish Antenna	800 -15,000	Yes
CB Radio	27.12	Yes
Cordless Telephone	46 - 5800	No
Cellular Telephone	824 - 850, 900, 1800, and 1900	No
Traffic Radar	10,500 and 24,000	No
Microwave Oven	915 and 2,450	No*
*Federal legislation requires that microwave ovens be constructed to meet stringent microwave leakage limits and to have safety interlocks. When these interlocks are defeated, for example, during repair work, there is a risk of overexposure to microwave radiation.		

RF Standards

- U.S.
 - IEEE/ANSI
 - C95.1 - RF/MW Exposure limits
 - C95.2 - Signage and S&H programs
 - C95.3 – Measurement
 - FCC
 - OET Bulletin 65
- Massachusetts
 - 105 CMR 122
 - NONIONIZING RADIATION LIMITS FOR: THE GENERAL PUBLIC FROM NON-OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELDS, EMPLOYEES FROM OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELDS, AND EXPOSURE FROM MICROWAVE OVENS

RF Exposure Standards are Typically Based on 6 min. TWA

- Excursions allowed if **6 min** time weighted average (TWA) is within limits for **occupationally exposed workers** (RF workers)
 - If a worker enters an **WARNING** area that was surveyed to have greater than 100% of occupational exposure for a 6 minute period, the worker would need to reduce the amount of time spent in the area so that the exposure when taken over the average of 6 minutes is LESS than 100%
 - Enters zone for 6 minutes -average exposure 100% for that 6 minute period
 - Leaves zone for 6 minutes -average exposure close to 0% for that 6 minute period
 - Repeat till work is done – average exposure over 6 minute TWA is approximately 50% exposure, well under the 100% limit for workers.
- Up to **30 min** intervals used for **public exposure** standards
 - Same method as shown below applies for members of the general public in **CAUTION** areas, but over longer time period and at lower exposure rates

RF Exposure

- Exposure to radio frequency (RF) fields results in the absorption of energy in the body
- The mechanism of this energy transfer is the body acting as an antenna for an RF source (i.e. RF source can be a tower, antenna, guide wire)

RF effects on the human body

- If the induced currents are large enough, tissue temperature rises
 - Tissue Heating
 - *Extremely critical in body parts that have limited cooling such as the eyes and testes*
- **NO** known lasting/long term effects over many scientific studies.
- At a certain rate of energy absorption biological effects also occur that can result in dizziness and confusion
- In the case of surface contact a shock hazard is also present
- In areas of high RF fields, RF energy can interfere with the programming of medical devices such as Cardiac Pacemakers or Cochlear Implants.

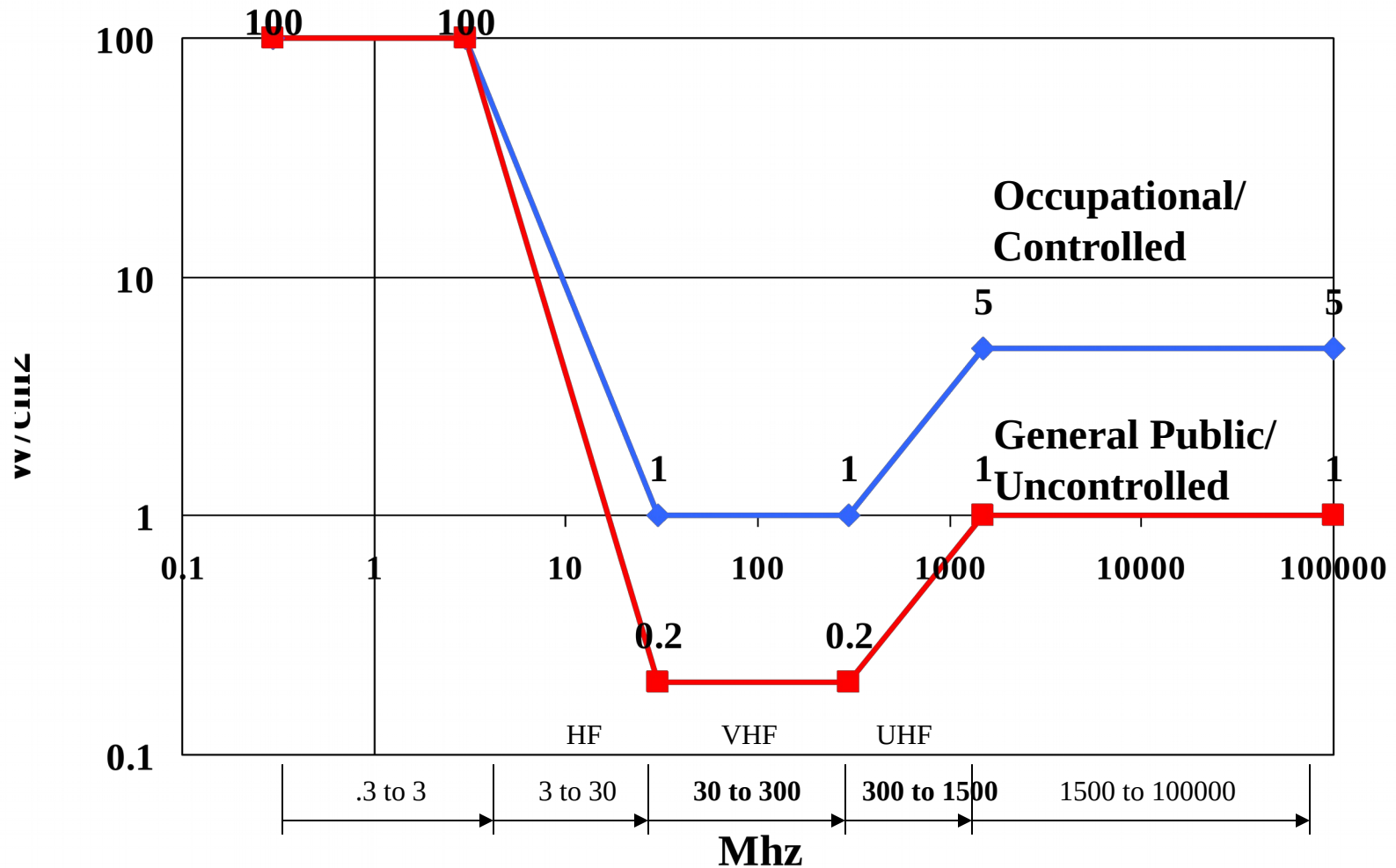
FCC RF Exposure Regulations

- Environments
 - A **controlled environment** is one in which the people who are being exposed are aware of the exposure and can take steps to minimize that exposure.
 - An **uncontrolled environment** is one in which the people being exposed are not normally aware of the exposure.
 - The uncontrolled environment limits are more stringent than the controlled environment limits.

FCC RF Exposure Regulations

- Maximum Permissible Exposure (MPE)
 - Regulations are designed to control **exposure** to RF fields, not the strength of RF fields
 - MPE limits are most commonly specified in:
 - Power density (mWatt/cm²)

MPE Power Density Limits



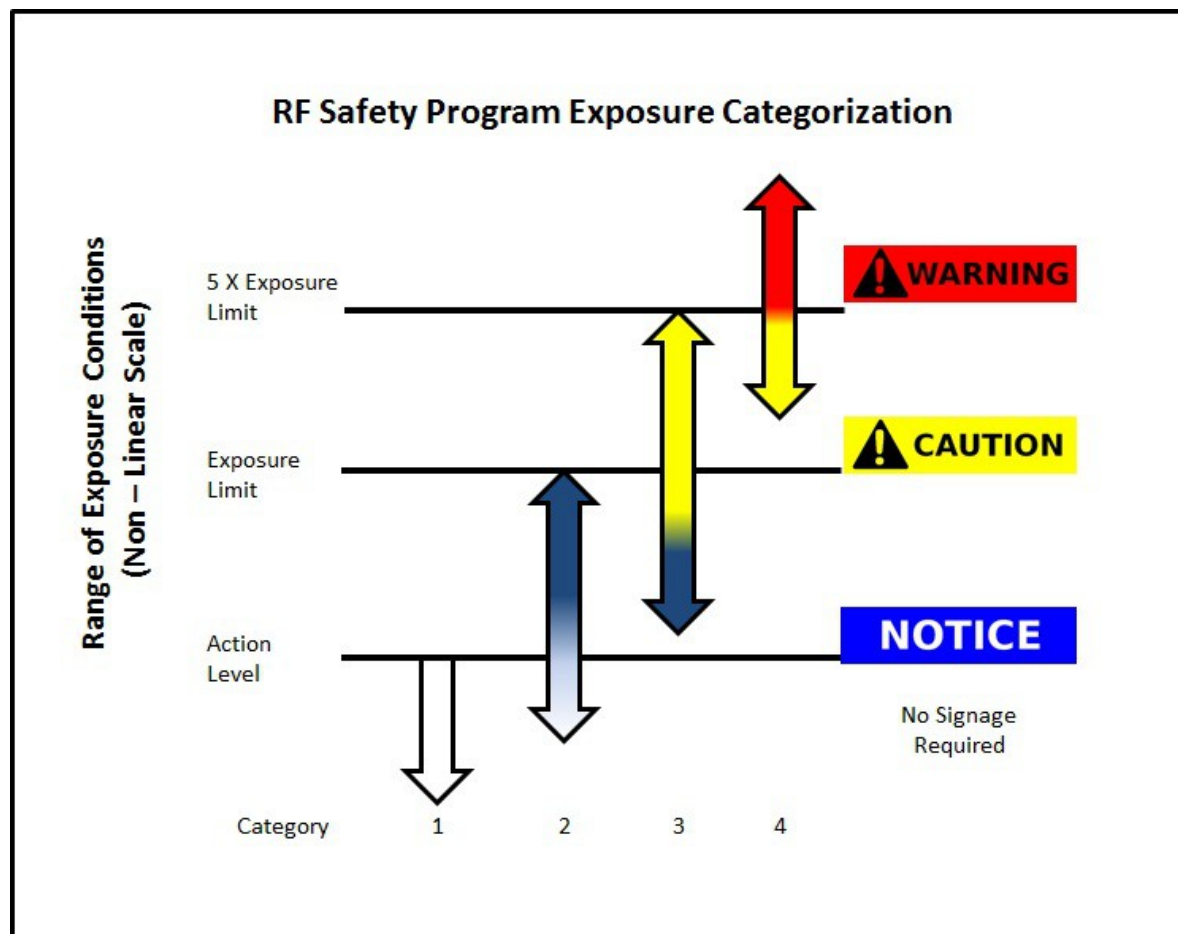
RF Exposure Limits to Maximum Permissible Exposure (MPE)

	Occupational Worker	General Public
Frequency Range	Power Density (mW/cm ²)	Power Density (mW/cm ²)
10 kHz - 3 MHz	100	20
3 MHz - 30 MHz	$900/f^2$	$180/f^2$
30 MHz - 300 MHz	1.0	0.2
300 MHz - 1500 MHz	$f/300$	$f/1500$
1500 MHz - 100 GHz	5	1

BU RF Safety Categories based on RF exposure conditions

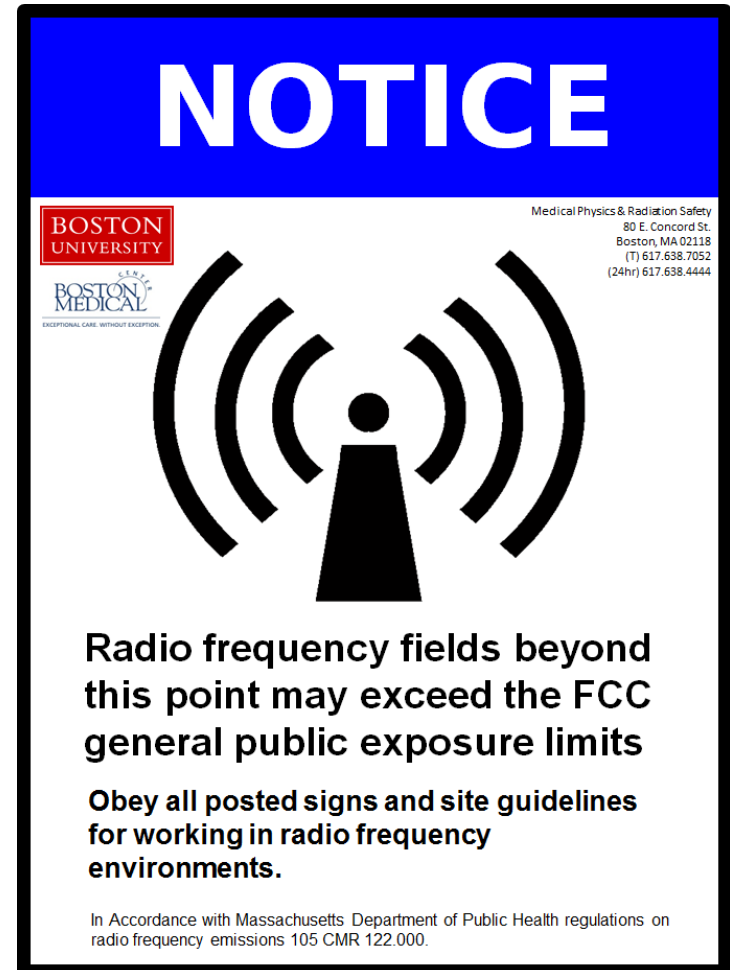
RF Safety Category	Exposure Condition	Occupational Action Level	Public Action Level	Control Actions required
1	Operational characteristics of source(s) would not cause the action level to be exceeded.	Below 2%	Below 10%	None, unless changes in equipment since last survey alter category.
2	Operations characteristics of source(s) could cause the action level to be exceeded but would not cause the exposure limit to be exceeded in accessible areas.	2%	10%	RF Notice Signage posted.
3	Potential to exceed the exposure limit in accessible areas, if mitigating controls are not applied.	20%	100%	RF Caution and Pacemaker Danger Signage posted, and control to access area is restricted.
4	Exposure will exceed exposure limit in accessible areas.	100%	500%	RF Warning and Pacemaker Danger Signage posted, Nardalert XT required, and control to access area is restricted.

Graphical Representation of RF Safety categories



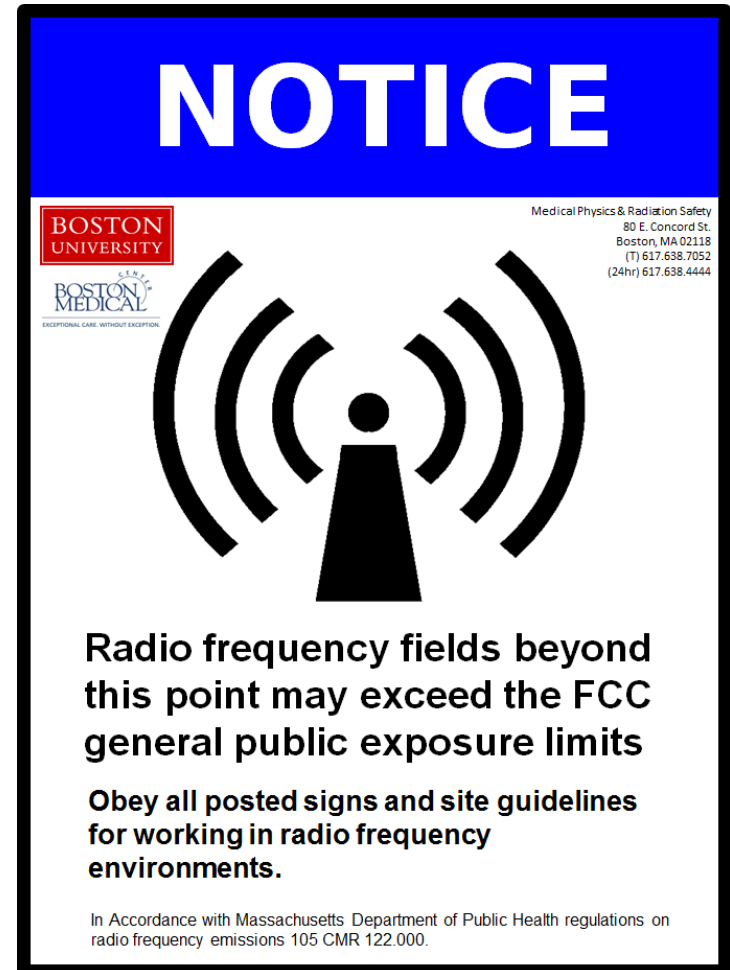
RF Notice Sign(s)

- Area where public exposure limit **MAY** be exceeded.
- RF Category 2
- Controlled Environment
- Excludes the general public.
 - Access **should be** restricted to general public for standard roof safety issues (locked door, padlocked hatch, etc.) but is not required
- General Public and Employees **should** limit time spent in this area.
- Perimeter of FCC Uncontrolled Limits



Response to RF Notice Sign(s)

- What do you do when you see a **NOTICE** sign?
 - Should not alter your work or job in any way
 - No one is excluded from this area, although it is recommended that both the general public and employees limit their time in this area.



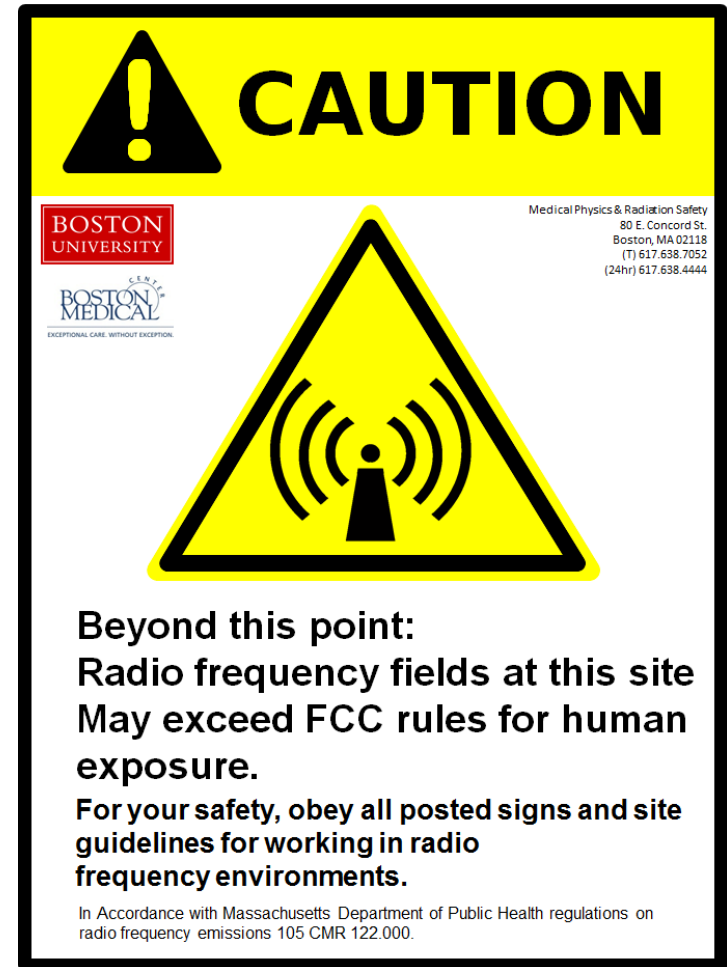
RF Notice Sign Locations

- 72 E. Concord
 - L building
- 33 Harry Agganis Way
 - Student Village 2
- 512 Beacon St.
 - Danielsen Hall
- 840 Harrison Ave.
 - Menino
- 44 Cummington St.
 - Engineering research Building
- 700 Commonwealth Ave.
 - Warren Tower A
- 881 Commonwealth Ave.
 - Registrar
- Picture (right):
 - Antenna on upper corner of Lower Roof on Menino Building (BUMC) – exceeds public exposure limits.
 - Lower level – accessible rooftop is marked with a Notice Sign



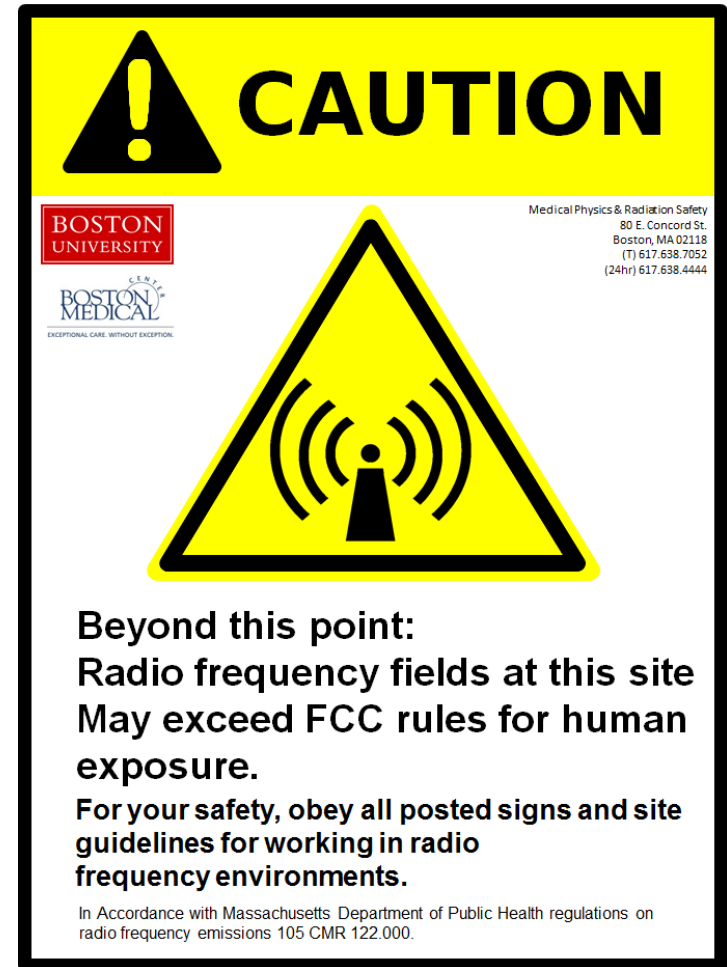
RF Caution Sign(s)

- Area where employee **may** be exposed, but exposure limit **MAY** not be exceeded
- RF Category 3
- Controlled Environment –**Restricted to the General Public**, NOT Occupational workers, provided they have training
- Awareness Training is Required to access this area
- Contact Radiation Protection or EHS prior to entering area
- Perimeter of Controlled Limits indicating need for protective measures (e.g., time averaging)



RF Caution Sign(s)

- What do you do when you see a **CAUTION** sign?
 - Should not alter your work or job in any way
- Look for antennas.
- If you do observe someone who you believe should not be on the roof (general public, lone student not with a group, etc.) ask them if they have taken the RF awareness training, get their name and call EHS or MPRS to verify. If they have not they are classified as General Public, and this area is restricted to them.



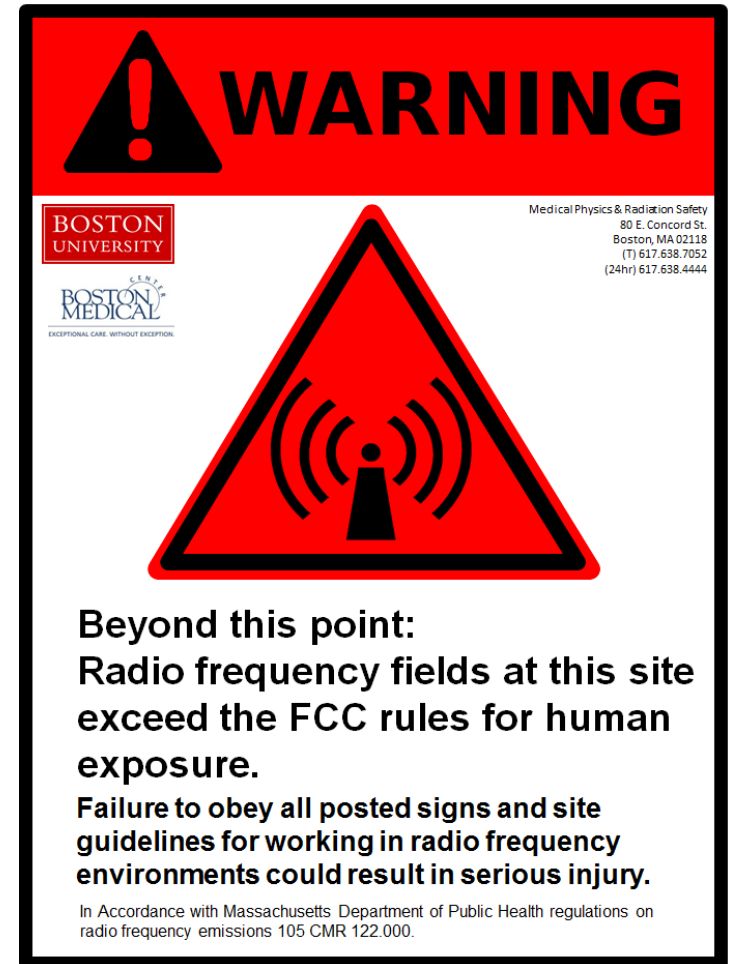
RF Caution Sign Locations

- 110 Cummington
- 765 Commonwealth Ave.
 - Law Tower lower level (when main WBUR antenna is energized)
- 685 Commonwealth Ave.
 - CAS-TSAI Roof
- 725 Commonwealth Ave
 - BU Astronomy
- Picture (right):
 - Cell Relay on upper penthouse (located on the right) exceeds public exposure limits but may not exceed employee limits.



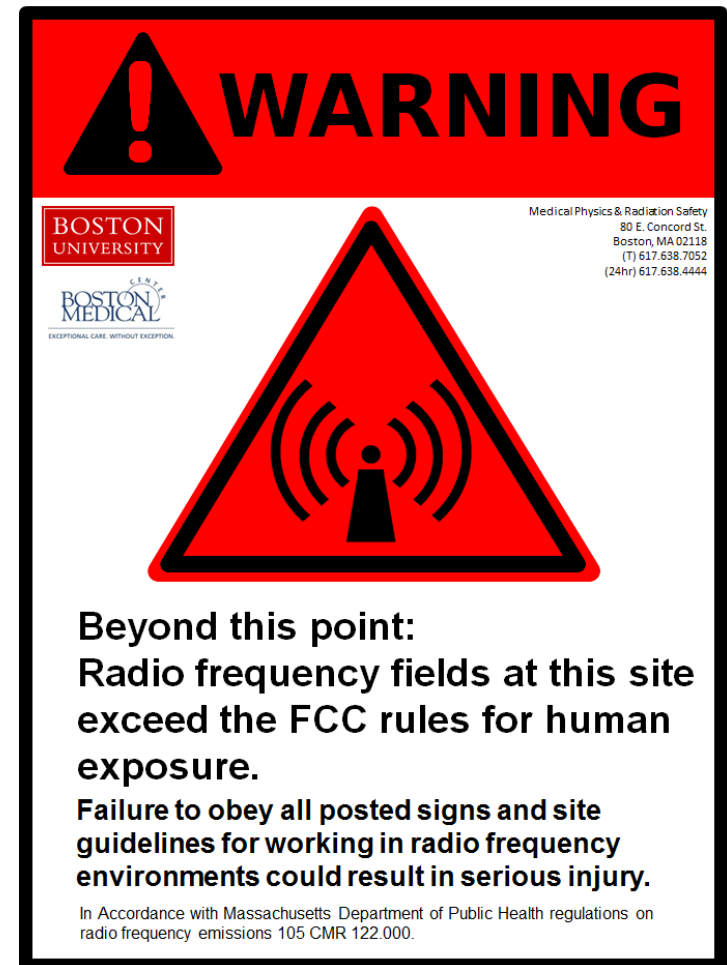
RF Warning Sign(s)

- Area where employee exposure limit **WILL** be exceeded
- RF Category 4
- Controlled Environment - **Restricted to the General Public**, NOT Occupational workers, provided they have training
- Awareness Training is Required to access this area
- Contact Radiation Protection or EHS prior to entering area
 - Personal RF dosimeters will be issued by either EHS (CRC) or Radiation Protection (BUMC)
- Contact Radiation Safety or EHS if you need to work close (within 4 ft.) to RF an source in this area.
- Time averaging is not feasible to prevent exposures at very High MPE's



RF Warning Sign(s)

- What do you do when you see a **WARNING** sign?
- Call EHS or MPRS to get a key and dosimeter prior to entering the area. WEAR the dosimeter. If it alarms, look at the level and move from the area of exposure. Use TWA 6 min intervals to complete work if need be.
- Look for antennas.
- If you do observe someone who you believe should not be on the roof (general public, lone student not with a group, another employee or contractor, etc.) ask them if they have taken the RF awareness training, get their name and call EHS or MPRS to verify. If they have not they are classified as General Public, and this area is restricted to them.



RF Warning Sign Locations

- 840 Harrison Ave.
 - Menino
- 750 Albany St.
 - Power Plant
- 700 Comm. Ave.
 - Warren Tower A
- 765 Comm. Ave.
 - Law tower (Upper rooftop when WBUR antenna is energized)
- Picture (Right)
 - Antenna on upper corner of Penthouse Roof on Warren Towers (A) (CRC) – exceeds occupational exposure limits.
 - Upper Level – Accessible by ladder on rooftop is marked with a Warning Sign



Pacemaker Danger Signs

- For areas of occupational exposure where limits exceed public action limits



Personal Protective Equipment (PPE)

- For employees that need to access rooftops that are marked RF Safety Category 4 (**Warning signs** posted) a personal dosimeter called the Nardalert XT will be issued to you by
 - Radiation Protection – Medical Campus (Ext. 638-7052)
 - EHS – Charles River Campus (Ext. 353-4094)



Contact Information

- Radiation Protection – Medical Campus
 - 72 East Concord Street
 - Evans Basement B01
 - 617- 638-7052
- EHS – Charles River Campus
 - 704 Comm. Ave.
 - 2nd Floor
 - 617 - 353-4094
- After Hours Emergency
 - Medical Campus
 - pgr. 617-638-5795 (ID#3471)
 - Charles River Campus
 - Phone: 617-699-6628
- Radiofrequency Protection Officer
 - Anthony Blatnica
 - 617-638-7054
 - blatnica@bu.edu

