

Commercial Radio Transmitter Sites Human Safety Considerations

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Transmitter Site Safety

- Transmitter Precautions
- RFR Issues
- Emergency Procedures
- Emergency Lighting
- Never work alone on high voltage or high current equipment
- Know CPR
- Know where the circuit breakers are!
- Wear Electric Shock Foot ware



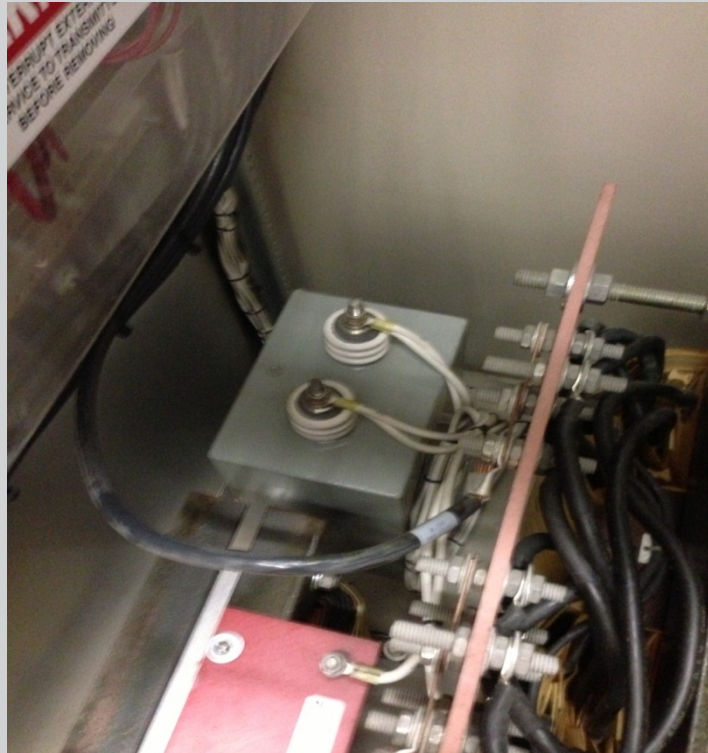
Clearly Identify All Circuit Breakers



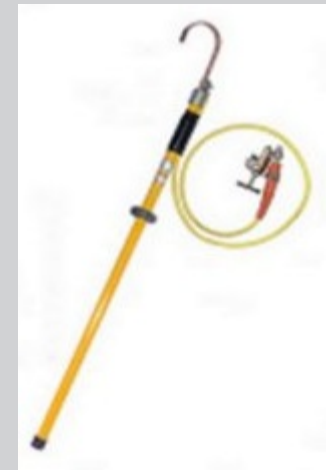
Battery Operated Emergency Lighting



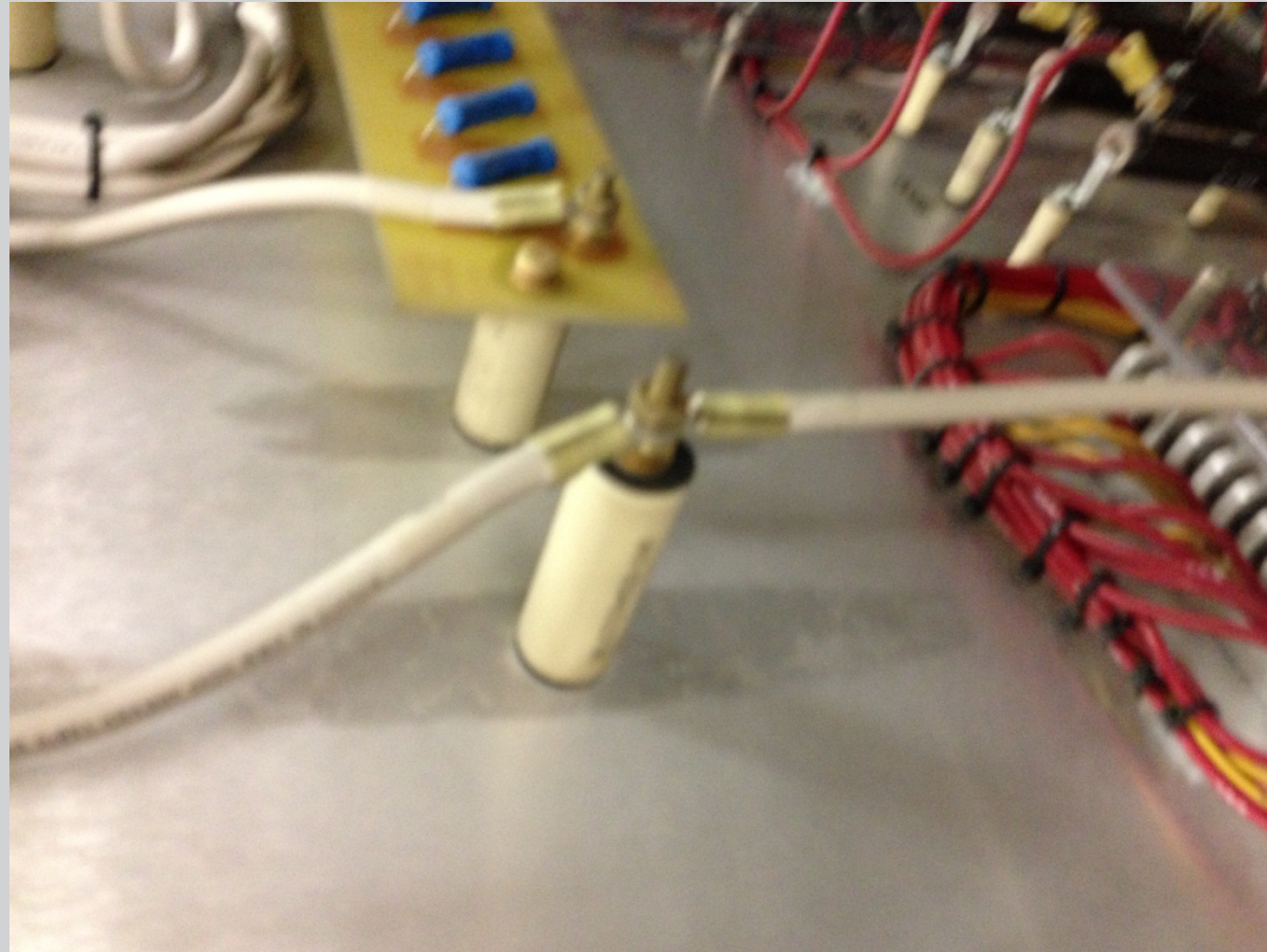
Typical High Voltage Filter Capacitor



The grounding Stick



Example of a High Voltage Terminal



Example of High Voltage Resistors



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Example of Transmitter Door Interlock



Secure Nitrogen Tank to wall



Secure Nitrogen Tank to wall



RFR Issues

- How does RF affect the human body?
- At what level does the body suffer adverse effects?
- At what level are the effects permanent?

Biological Effects of RF Exposure

- Heating of human body tissue
- Electro stimulation (RF Shocks and burns)
- Exclusively an occupational problem
- Rooftops are the most common locations for concerns



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Typical Rooftop Installation



Outside Building RF Indicator



RFR Issues

- The body heats up in the presence of significant RF Energy
- The better an antenna you are, the more RF Energy will be absorbed
- Most people are good antennas at or near FM Frequencies
- Metal Rod Antenna impedance = 2-3 ohms
- Average Human Body impedance = 360 ohms
- Lost RF energy converted into heat



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How much RF Exposure can really hurt me?

- Energy/Mass
- Sleeping 1.0 W/kg
- Moderate Exercise 2.25 W/kg
- Max Exposure without risking permanent damage 4.0 W/kg
- Fluid Levels averaged over entire body
- The eyes are particularly vulnerable to RFR due to limited blood flow and inability to cool.
- Time is also a factor in that the body can only take very short term exposure to extremes of heat and cold
- Human cells die at 107 degrees F



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Electro stimulation

- Shock or RF Burn
- Requires contact with an RF Radiator or Re Radiator
- Touching a live antenna causes RF current to flow through your body to ground
- Any ungrounded conductive object in a strong RF Field will be illuminated and re-radiate



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Shock or Burn Factors:

- Strength of the electric field
- RF Frequency
- How well grounded you are
- Surface area of the body that contacts the RF Source
- A surge of energy occurs at the point of contact and results in a shock and possibly an RF Burn
- Lightly touching a radiator with a fingertip is the worst thing you can do, since the total current flows through a very small area!



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Shock Dangers:

- You can feel >1 ma AC @60 HZ or 5ma DC
- >10 ma AC can cause a 150 Lb person muscle contractions
- >30 ma AC Tissue Damage/Fibrillation
- 300 ma - 500 ma DC Tissue Damage /Fibrillation
- Heating due to resistance can cause internal burns



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Lethality of Shock Factors:

- Current
- Duration of shock
- Pathway through body
- High Voltage (>600) Dielectric breakdown at skin increased current flow



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How do I protect myself?

- Use common sense!
- Have a professional survey done making quantitative measurements and specific recommendations
- Insist on a RFR Safety Program, crafted by a professional RF Safety expert, and follow it!
- Mark areas on the rooftop that risk high exposure levels
- Make extensive use of signage, and locked ladders, and doors to make restricted high exposure areas inaccessible to the public and untrained personnel



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Typical RF Exposure Meter



Typical RF Exposure Meters (personal Monitors)



Exposure FCC Maximum Limits (Occupational/Controlled) Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density ² (mW/cm)	Averaging Time (minutes)
0.3-3.0	614	1.63	100	6
3.0-30	1842/f	4.89/f	900/f	6
30-300	61.4	.163	1.0	6
300-1500	---	---	f/300	6
1500-100,000	---	---	5	6

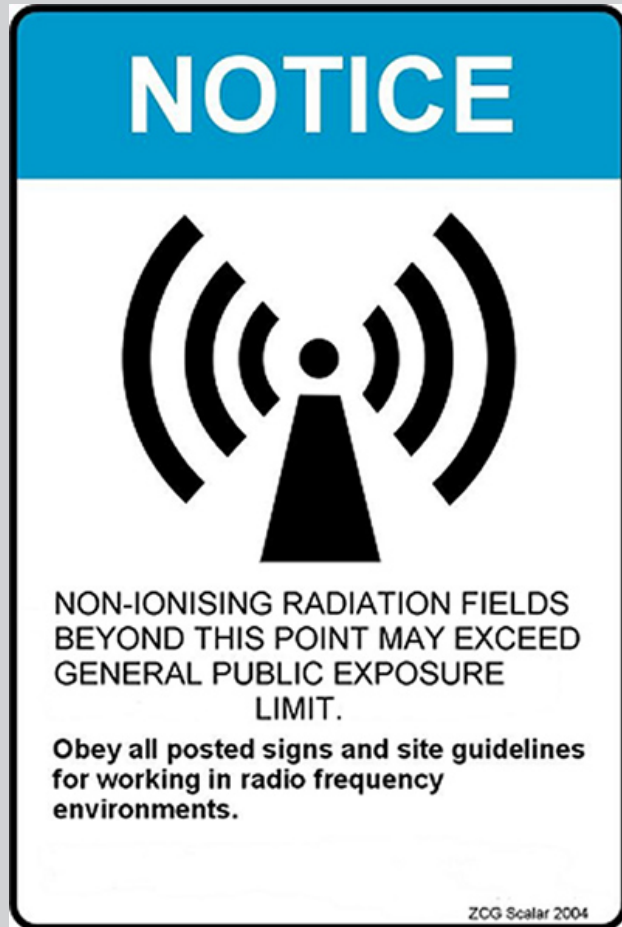


Exposure FCC Maximum Limits (Public) Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density ² (mW/cm)	Averaging Time (minutes)
0.3-1.34	614	1.63	100	30
1.34-30	824/f	2.19/f	180/f	30
30-300	27.5	.073	.2	30
300-1500	---	---	f/1500	30
1500-100,000	---	---	1.0	30



Typical RFR Signage



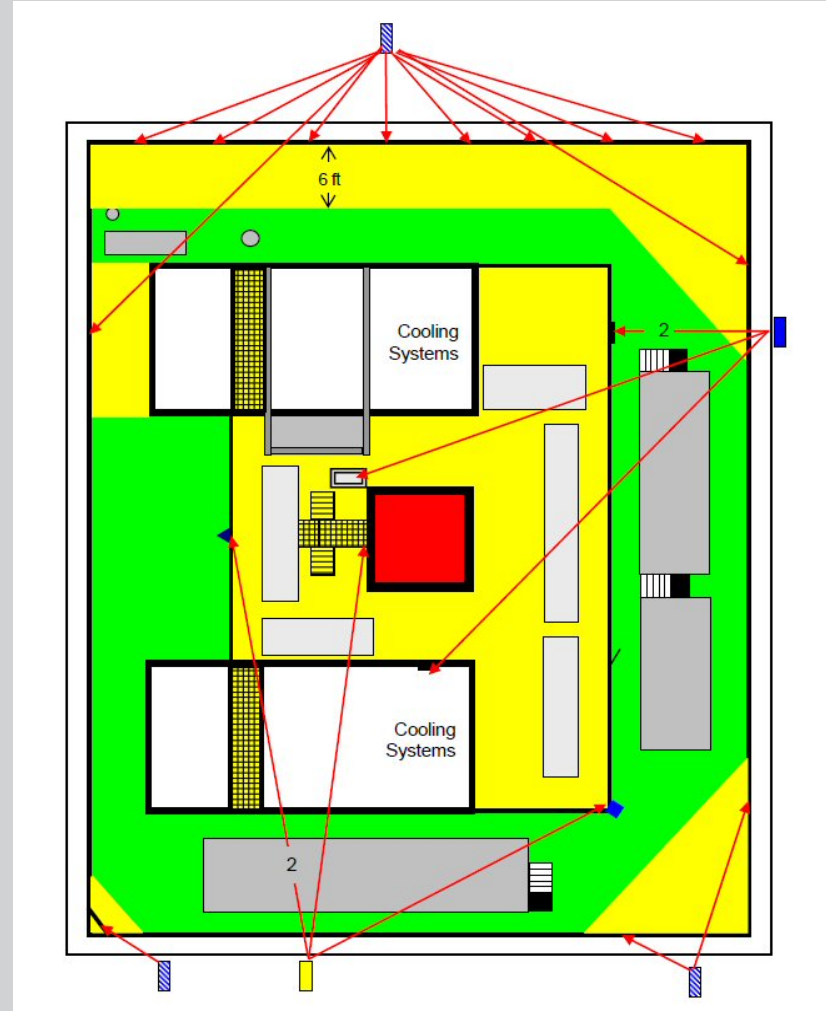
Typical RFR Signage



Typical RFR Signage



Prudential RF Signage Plan



- Richard Strickland: RF Safety Solutions
- Has done surveys for the company I work for
- Wrote the book on some of the most popular RF Survey Products
- Provides Surveys and training
- RFSafetySolutions.com
- Includes links to many papers on RFR safety



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