

Commercial FM Radio Transmitter Sites

Common Redundancy Methods

Paul Shulins – Greater Media Boston

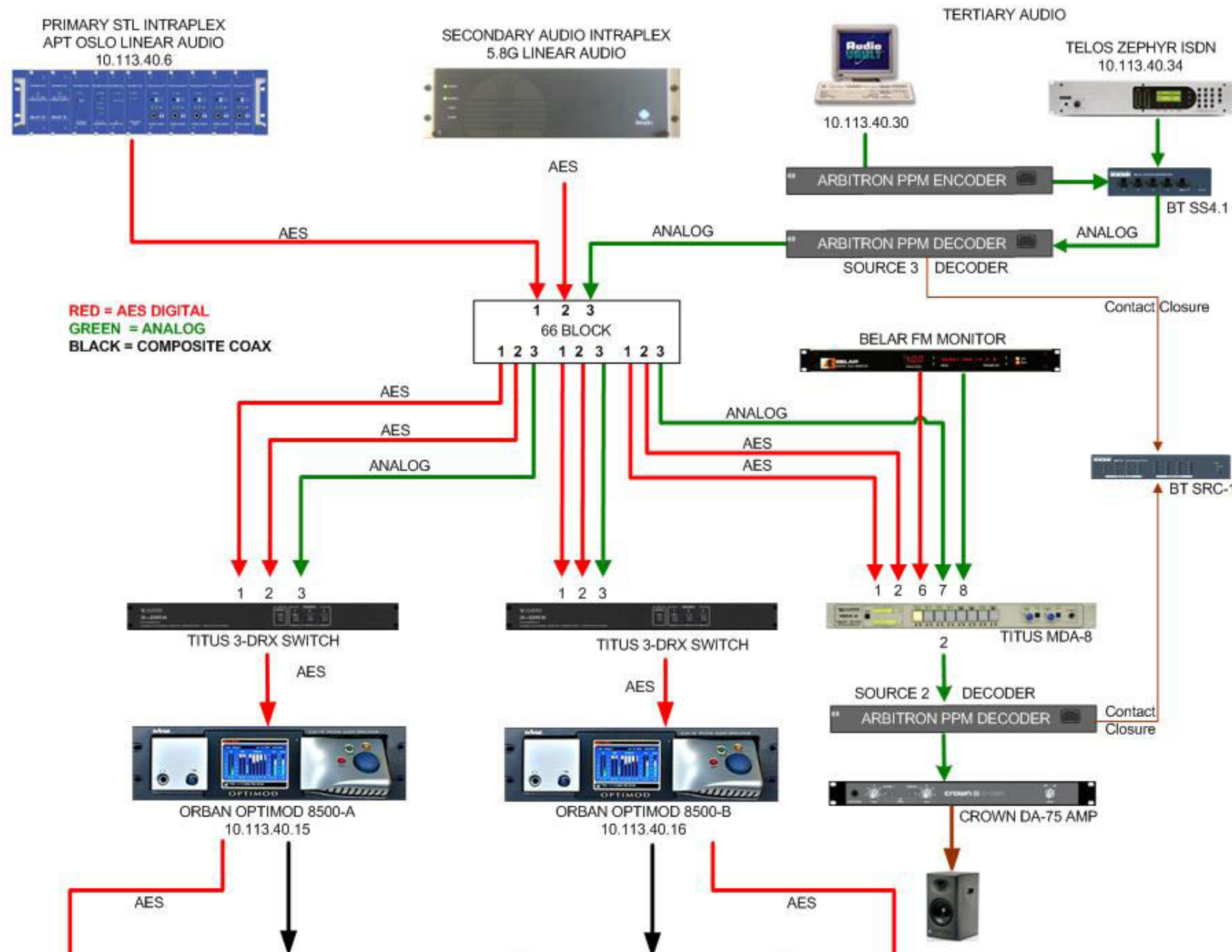


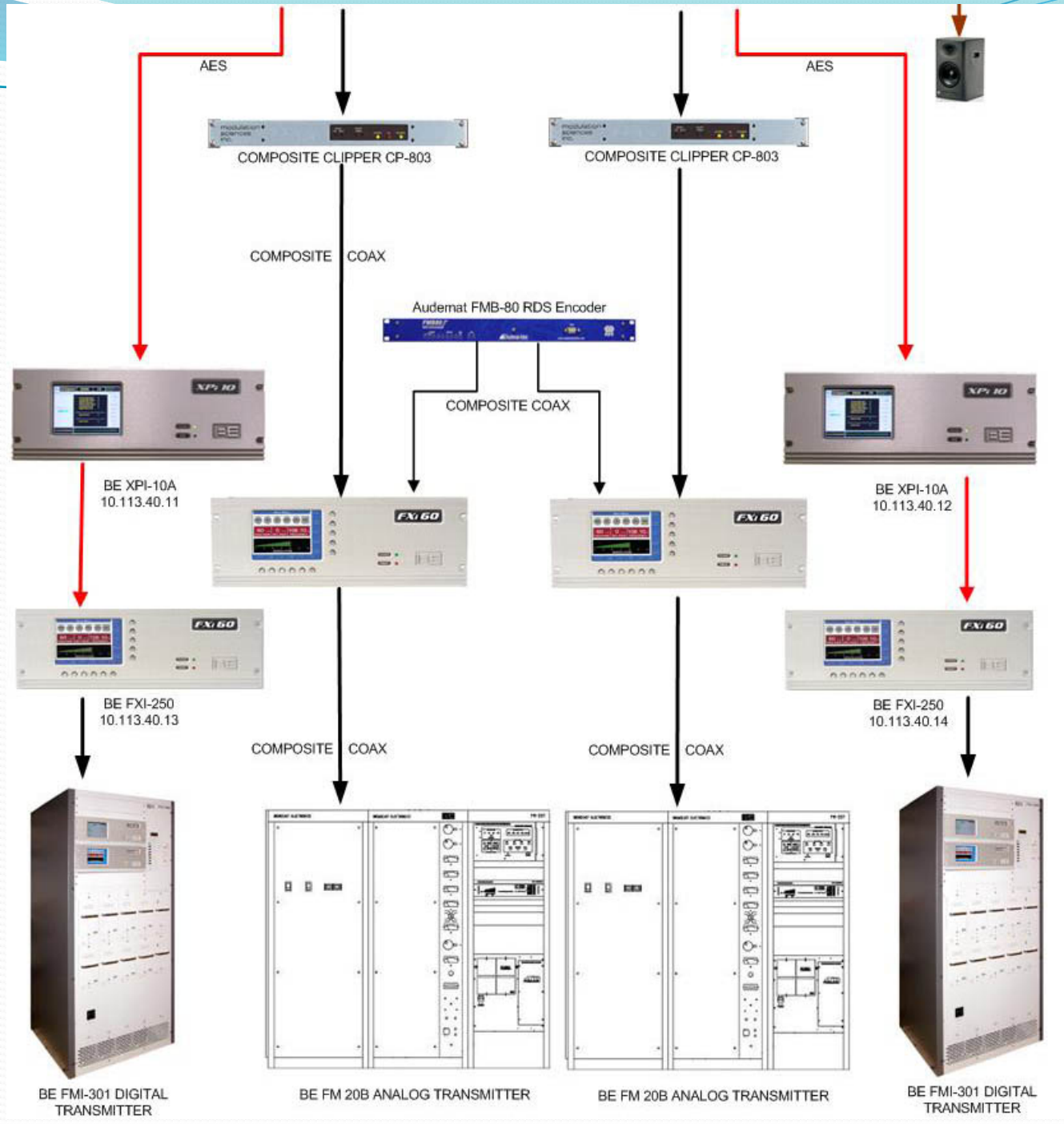
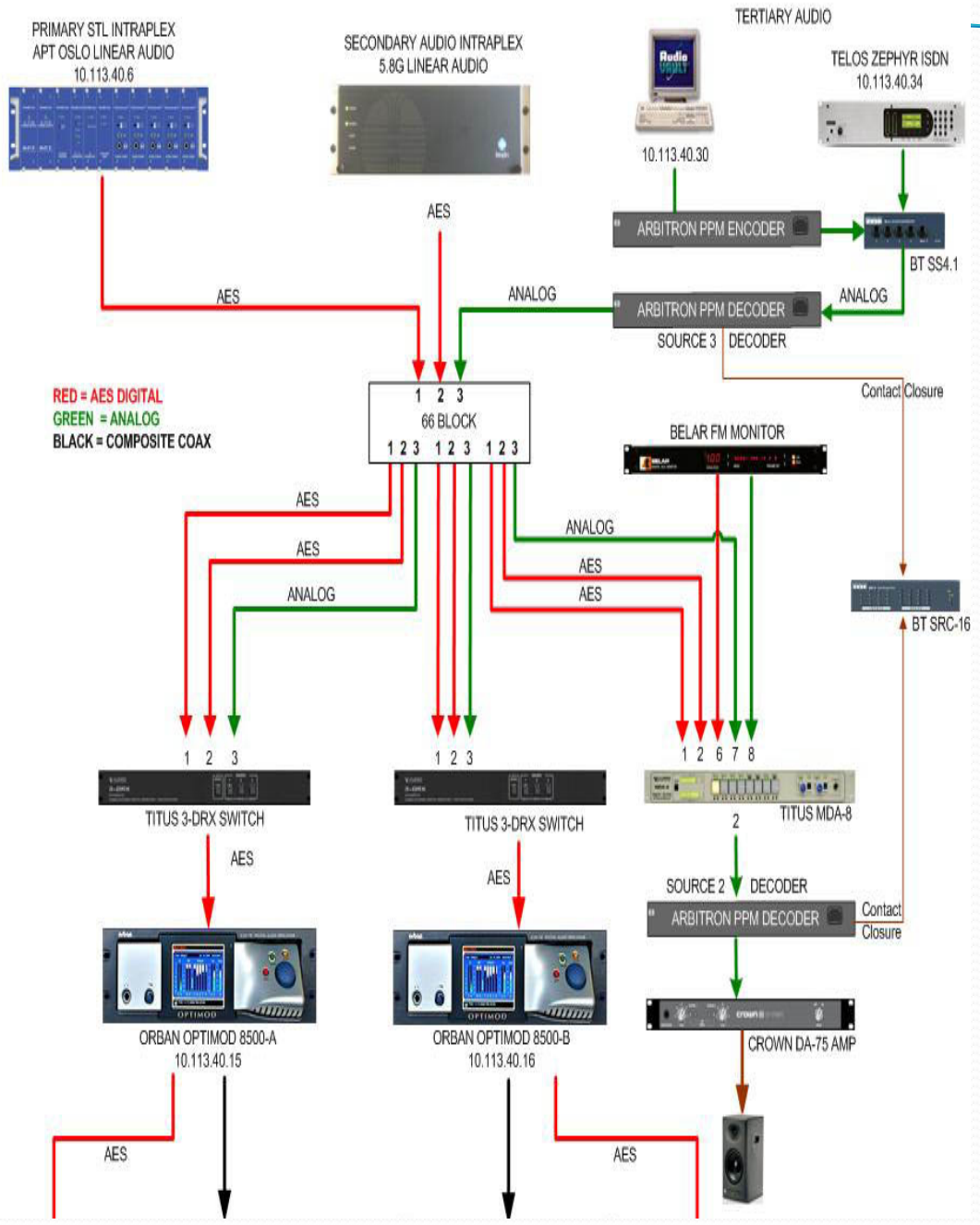
Transmitter Site Safety

- 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 Footware



Greater Media COUNTRY 102.5 WKLB NEEDHAM TRANSMITTER SITE SIGNAL FLOW





FM Combiner Systems Advantages:

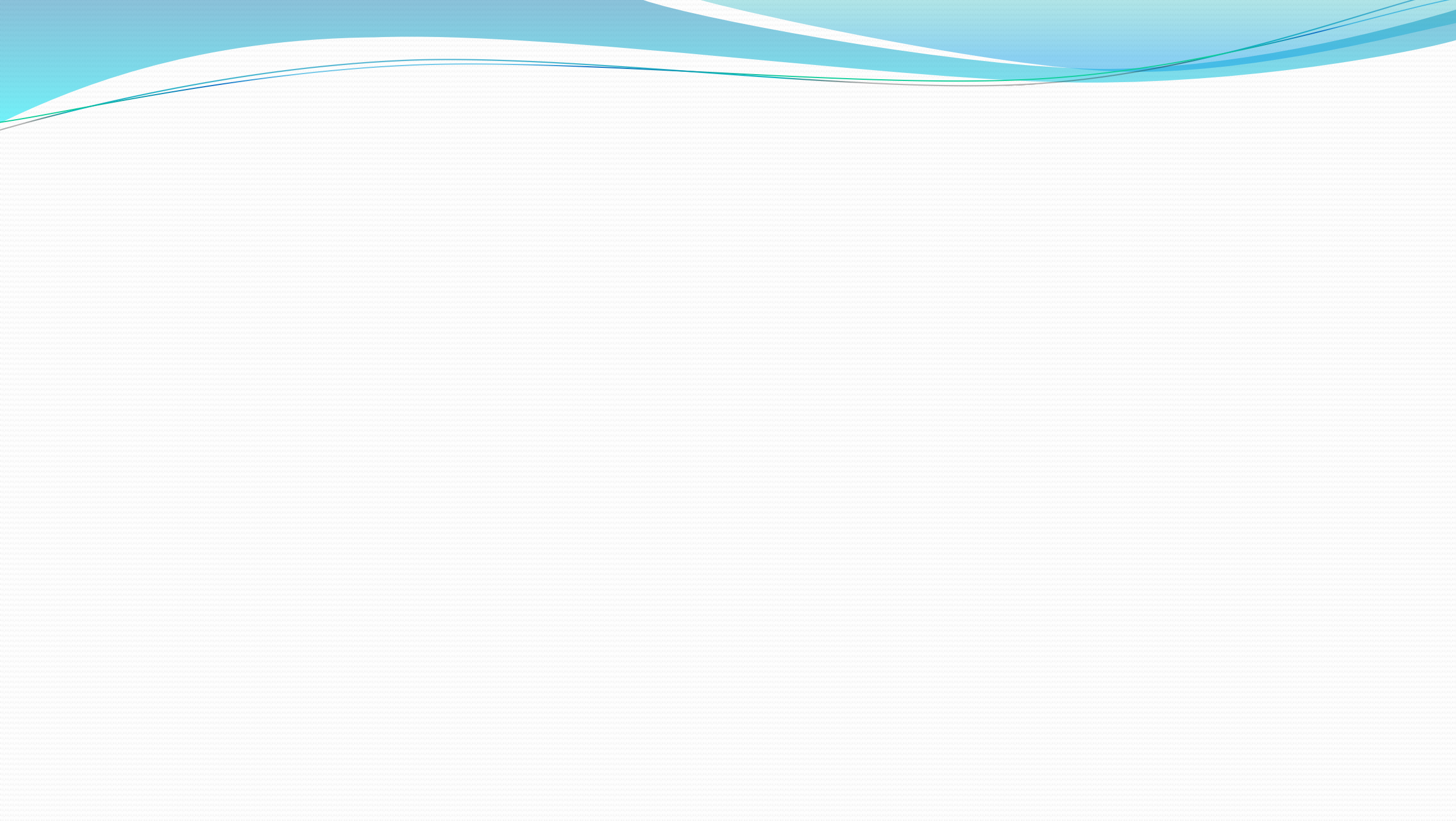
- Real Estate on towers or rooftops is used most efficiently
- Most intermodulation Products are eliminated
- Leverage the buying power of many companies to provide an advanced design antenna with optimum coverage of the target population
- Larger Broadband Antennas that can handle multiple frequencies usually have better immunity from icing effects
- Allow for individual stations to benefit from the best antenna locations



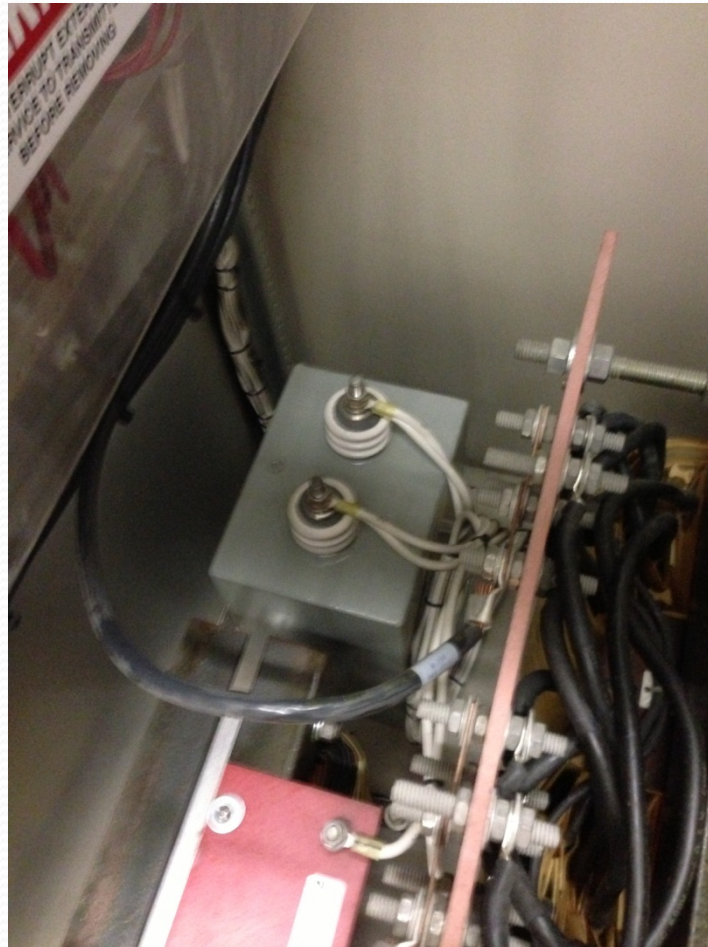
FM Combiner Systems Disadvantages:

- High Up front cost to build and install
- Agreements required between radio stations
- Cooperation for VSWR Protection Enforcement Required
- All Changes must be agreed to by committee





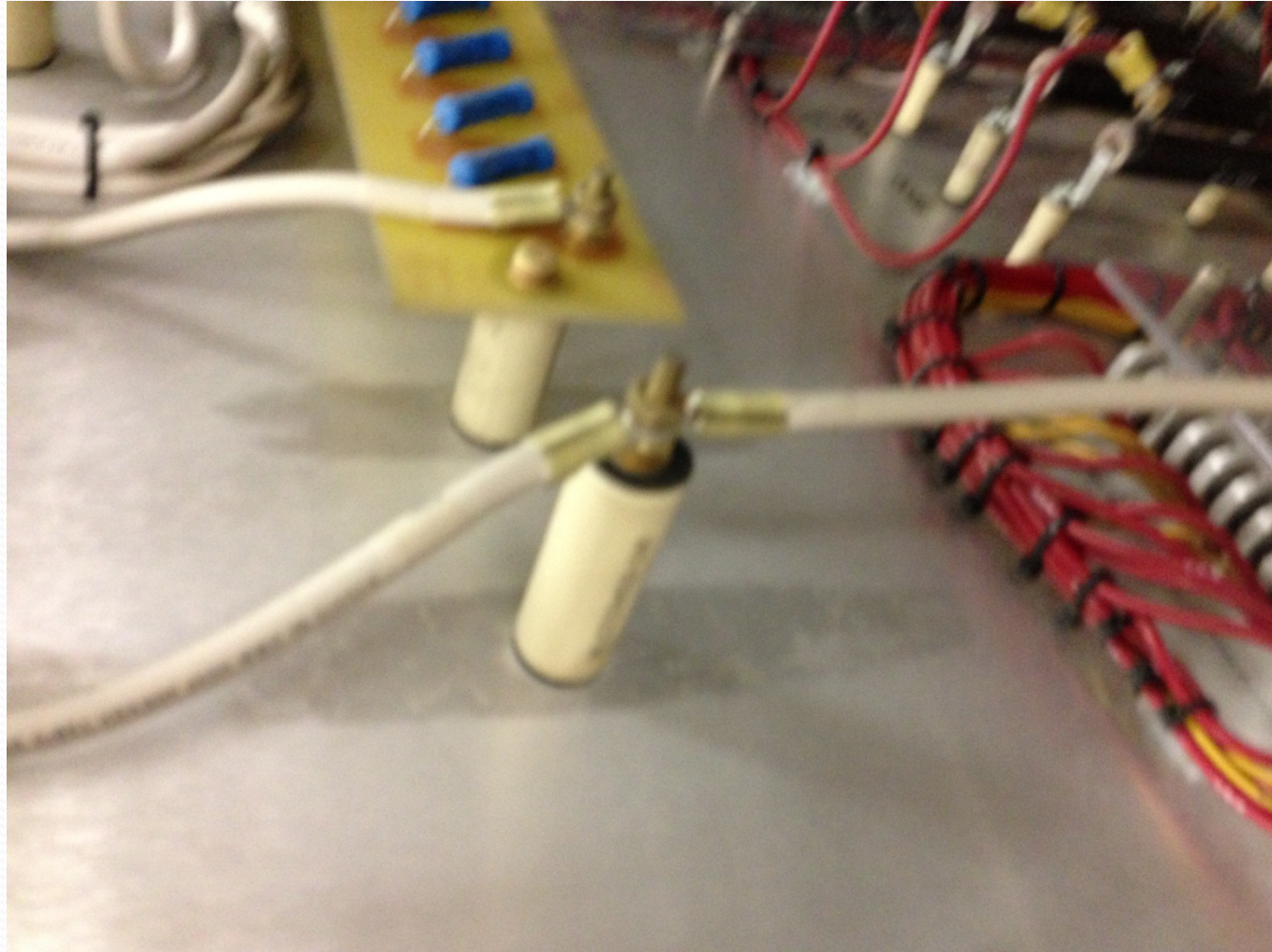
Typical High Voltage Filter Capacitor



The grounding Stick



Example of a High Voltage Terminal



Example of High Voltage Resistors



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



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



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



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



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!



Typical RF Exposure Meter



Typical RF Exposure Meters (personal Monitors)



FCC Maximum Exposure 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




FCC Maximum Exposure Limits (Public/Uncontrolled) 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

NOTICE



NON-IONISING RADIATION FIELDS
BEYOND THIS POINT MAY EXCEED
GENERAL PUBLIC EXPOSURE
LIMIT.

Obey all posted signs and site guidelines
for working in radio frequency
environments.

ZCG Scalar 2004

⚠ WARNING



Radio Frequency Energy Hazard Inside
Do Not Enter!
Risk of Serious Injury or Death
Use exposure control procedures.
Refer to site policy.

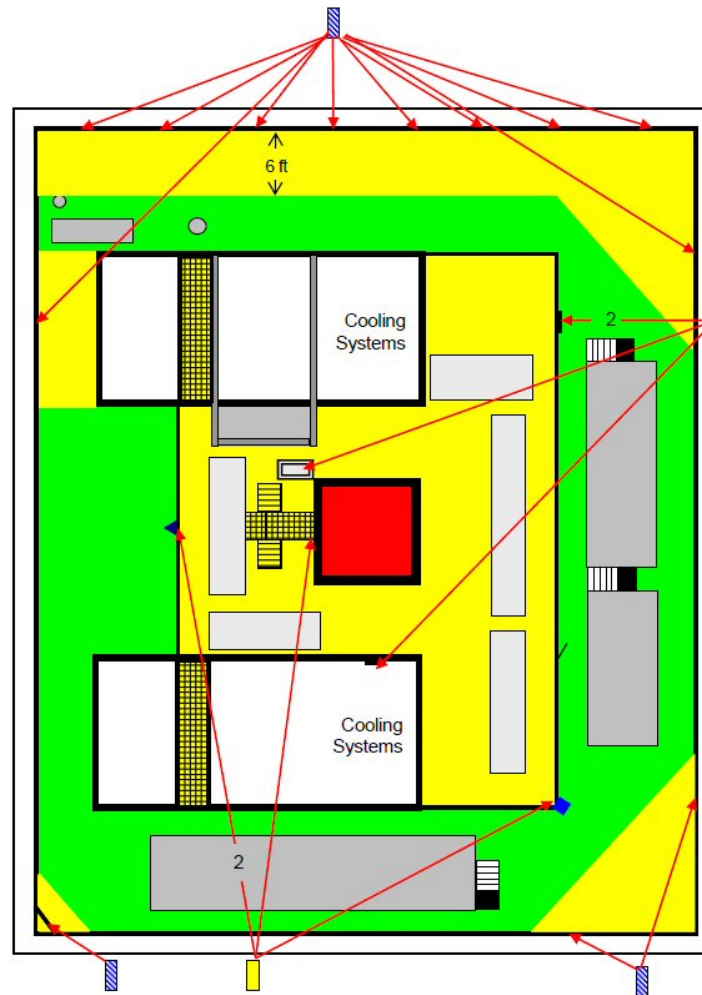
⚠ ADVERTENCIA

Riesgo de energía de radiofrecuencia en el interior.
¡No entre!
Riesgo de una lesión grave o muerte.
Siga los procedimientos para controlar su exposición.
Consulte las políticas de las instalaciones.

WN202 ANSI Z535.1-2006, Z535.2-2007 IEEE C95.2 - 1999, C95.7 - 2005 ©RFSigns.com



Prudential RF Signage Plan



Acknowledgements/Reference Source:

- 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

