Around the World, Across the Spectrum, Your Single Source For Broadcast Solutions.

Designing a 19 Station Broadcast System

Featuring: Empire State Building, NYC


Antennas


Transmission Line


Towers


Filters/Combiners


Broadcast Services

Nick Paulin

Site Location

System goals

- Provide superior coverage to the NYC metropolitan region
- Provide a full power auxiliary system to the current broadcast system
- Meet or exceed occupational hazard RF level limits in and around the antenna array
- Meet or exceed public exposure limits in and around areas open to the public

Challenges

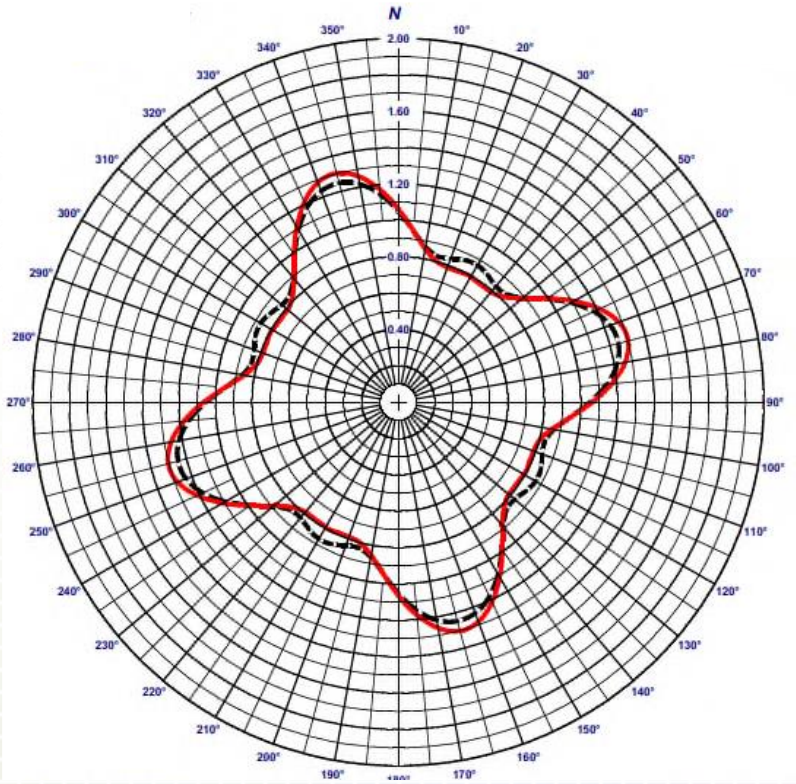
- 19 full power Class B broadcast facilities
  - All operate FM analog and IBOC carriers
- Building is located in Mid-town Manhattan, NYC
- Logistics of moving big equipment in and around a popular national historic building

Antenna Considerations

- Pattern Shaping
  - Azimuth pattern
  - Elevation Pattern
  - Assembly considerations

Typical Azimuth Pattern

- Pattern Shaping
  - Azimuth pattern utilized comb filter



Outdoor Range

Source Antennas

Test Tables

Performance Testing

The full antenna

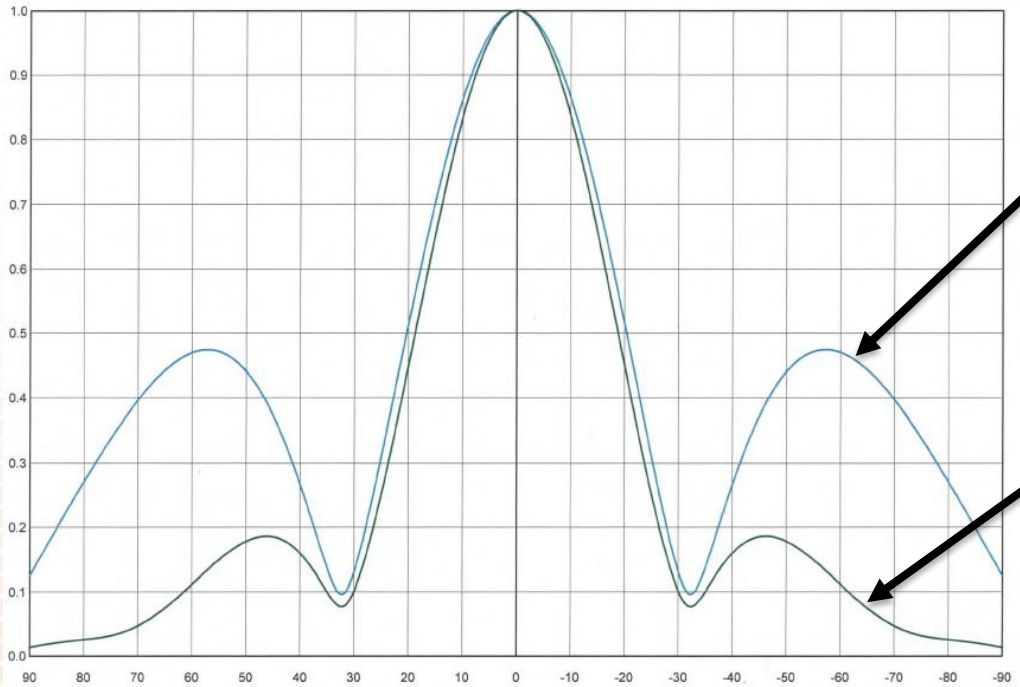
Turn table, outdoor range

Office entrance

Scientific Atlanta
50,000 lb thrust rating
196,000 lb overturn rating

Vertical Plane Pattern

- Elevation Pattern shaped by an $^{N-1}/_{N}$ Array

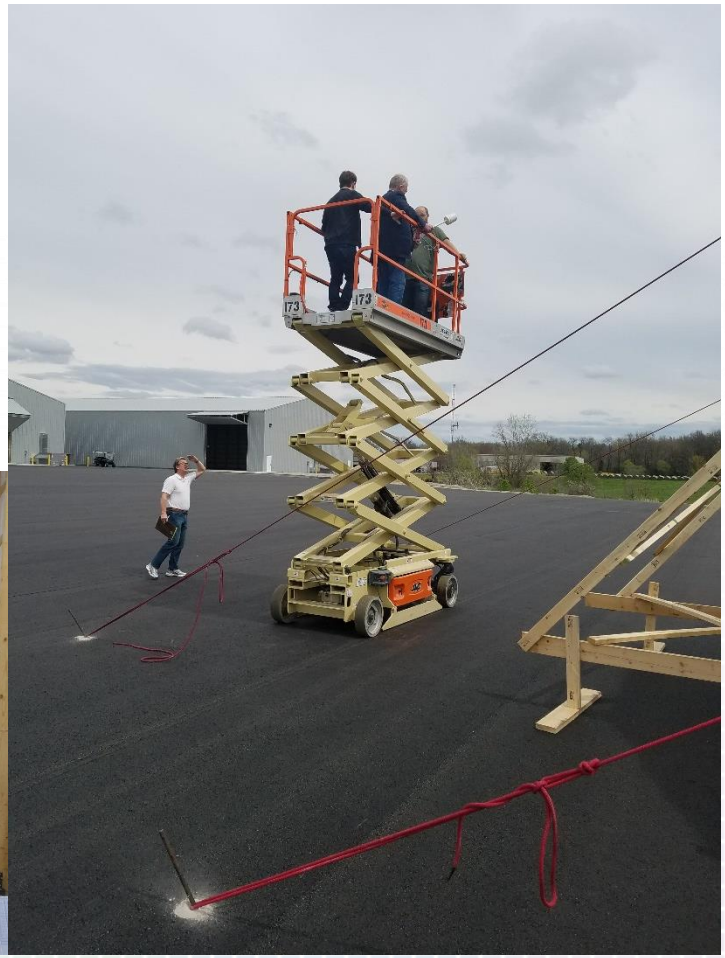


Full Wave Spaced
2 Bay Array

Reduced downward
Radiation using $\frac{N-1}{N}$

Proof of Performance Tests

- Instruments:
  - FIM 71 Field Meter
  - Frequency Generator
  - Power Amplifier
  - HP Power Meter



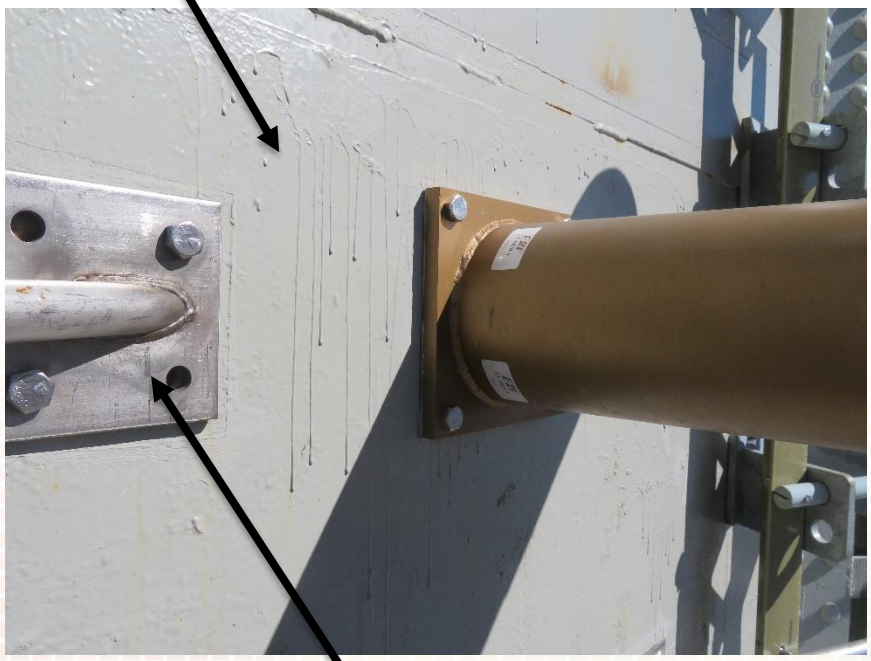
Proof of Performance Tests

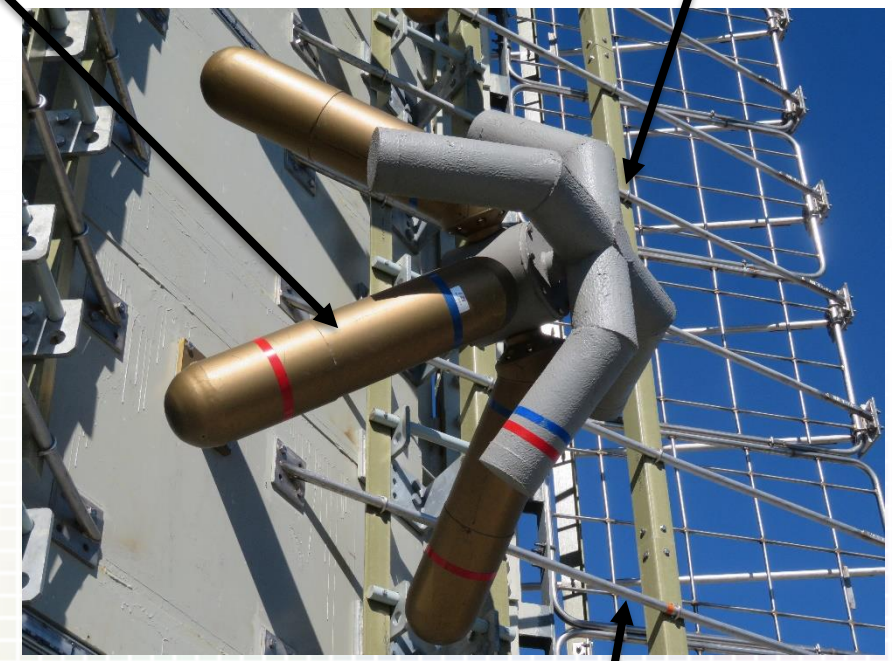
Full Scale Replica of
Ice Bridge

Proof of Performance Tests

- Instruments:
  - FIM 71 Field Meter
  - Frequency Generator
  - Power Amplifier
  - HP Power Meter

Array Construction



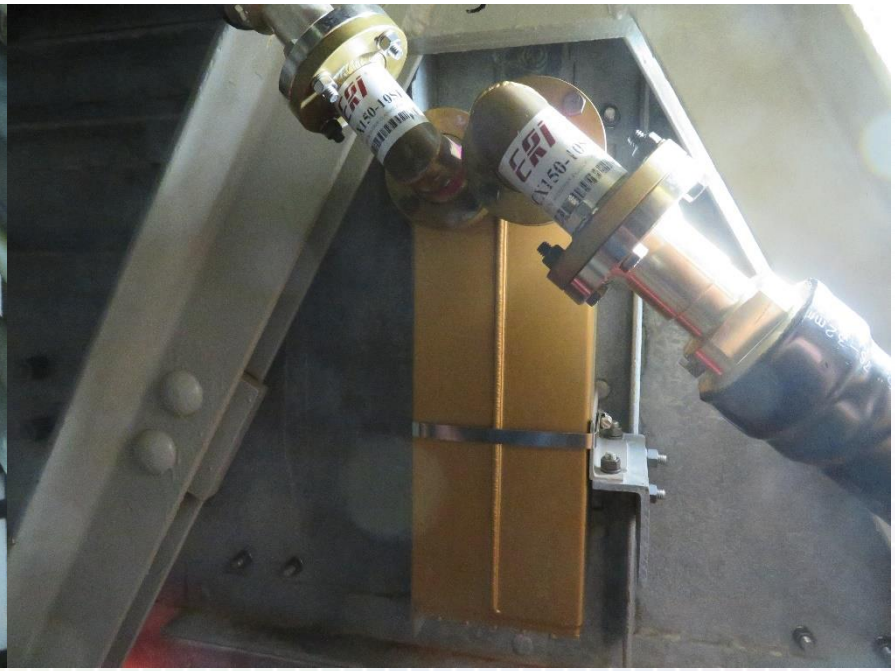


Maintenance

Comb Filter

Fiberglass step ladder

Voltage Analysis



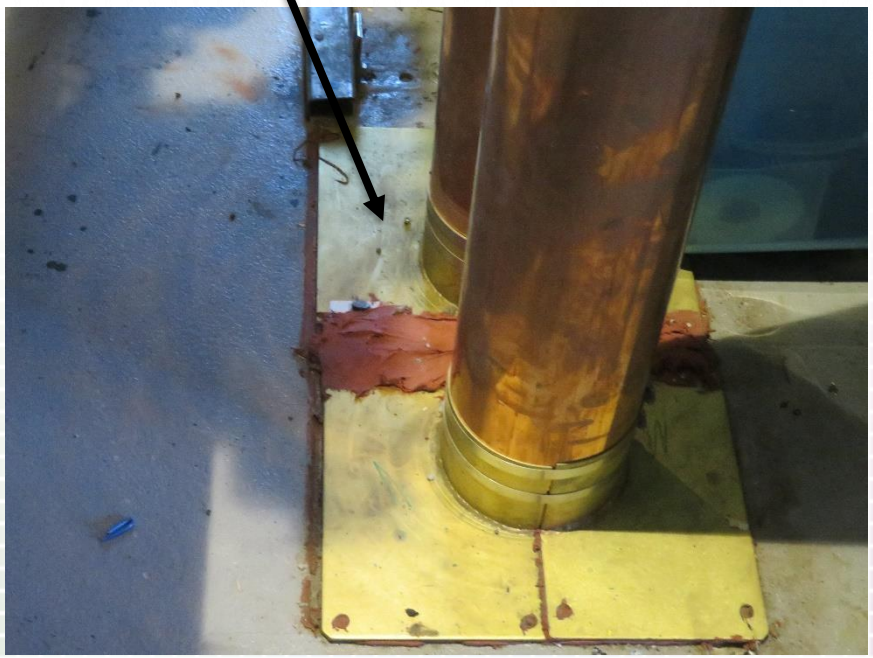
Transmission Line

- Transmission line Segment length of 8’
  - Easy to move through a building
  - Near identical performance of 17.5’ segments when calculating flange reflections

Transmission Line Runs

Dual 6-1/8” Transmission Line routings

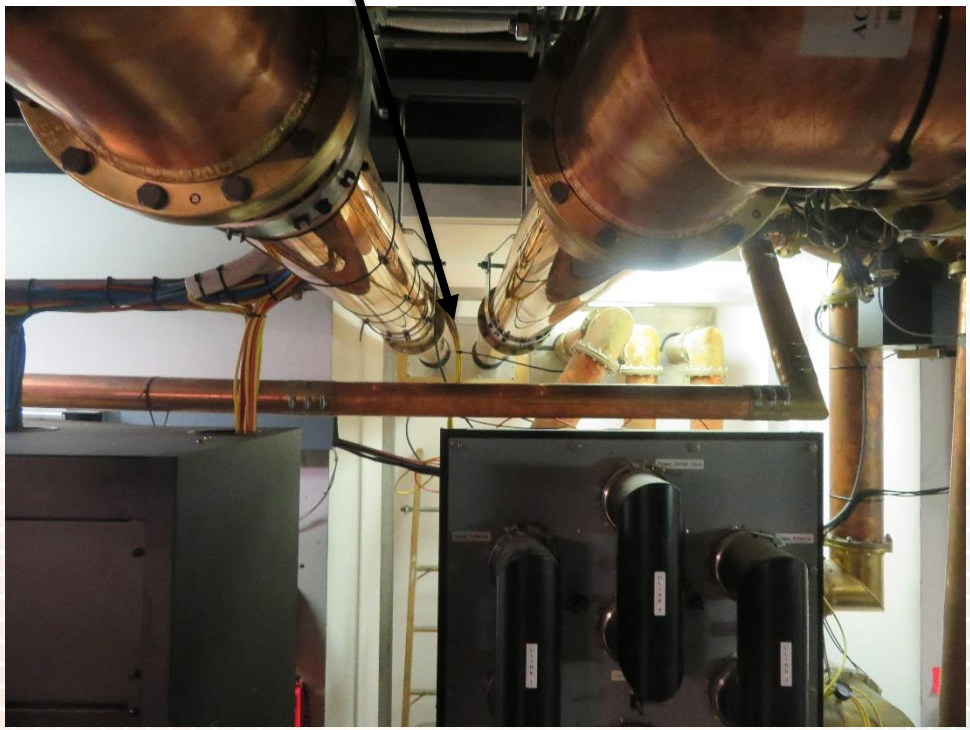
One new penetration through dome

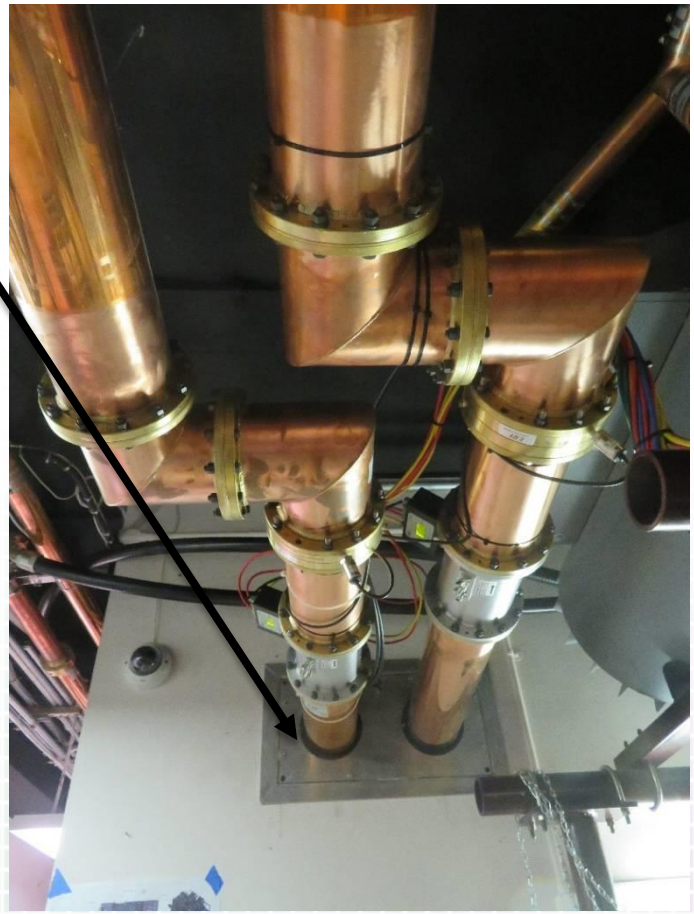


Transmission Line Wall transitions

To Antenna

From Aux Combiner





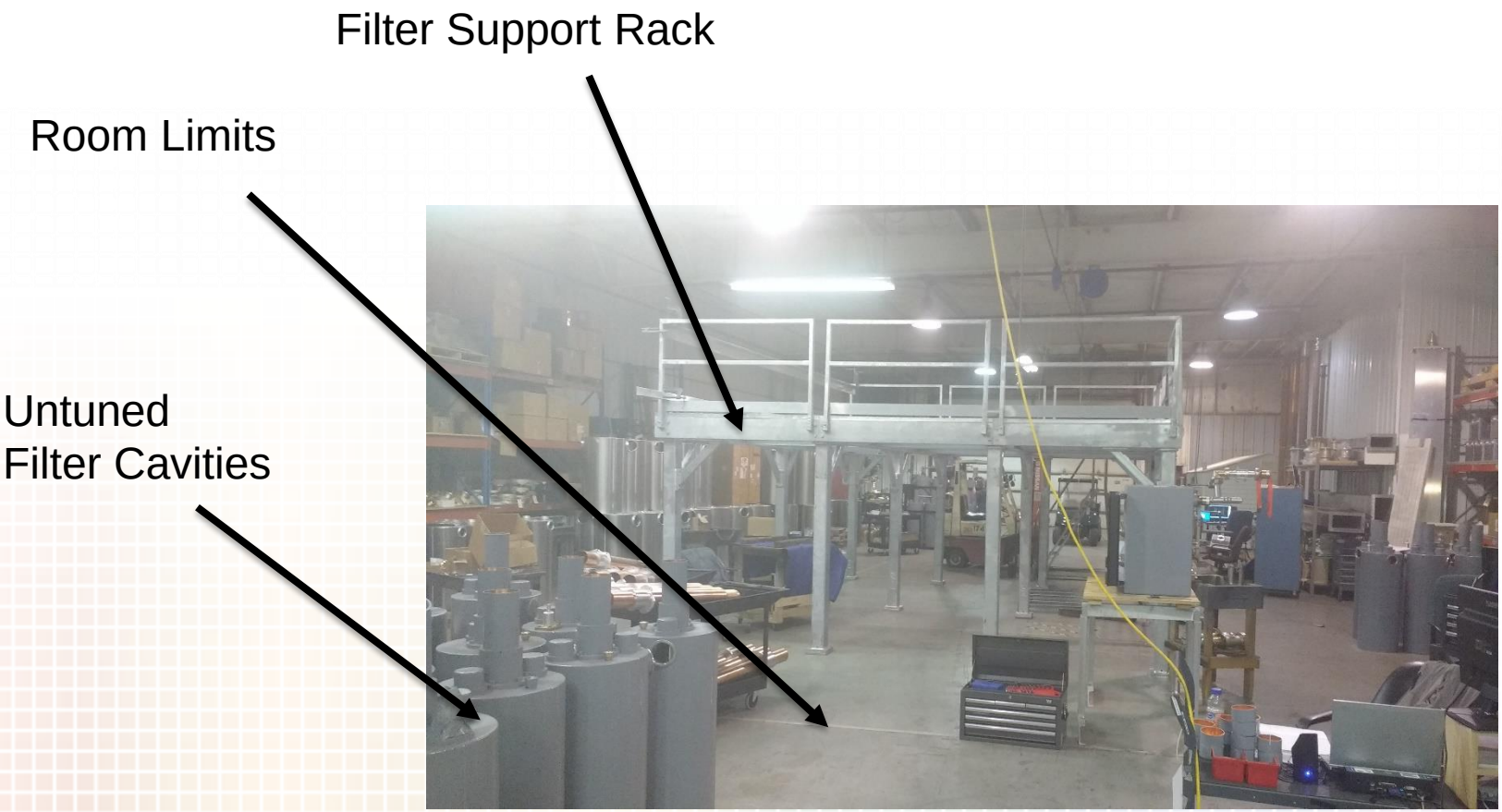
FM Combiner

- 10 Station Combiner + 9 Station Combiner
  - Eliminates need to phase match output transmission lines to antenna
- Balanced CIF design
- Operating frequencies are staggered to eliminate all 800 kHz spaced adjacencies
  - Improves group delay performance

Combiner Room Challenges

- Room is approximately ½ the size of the Master main combiner system. Floor space is a luxury.
- Ceiling height is limited by existing ductwork

The Combiner Room



Modular Filter Racks

Connection Joint

Combiner Assembly

Combiner Assembly

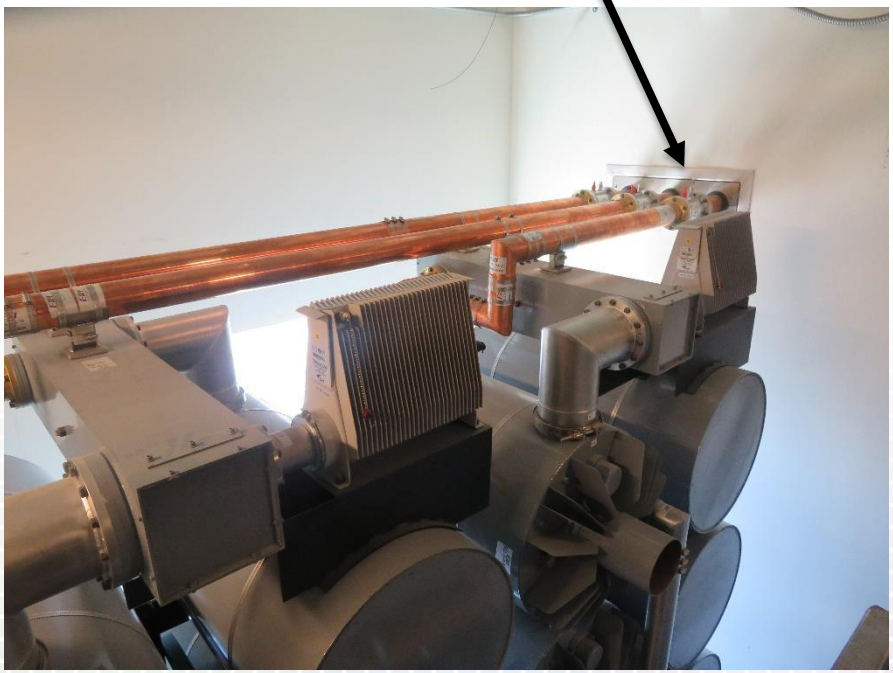
Combiner Assembly

Horizontally Racked Filters

Upper Deck

Lower Deck

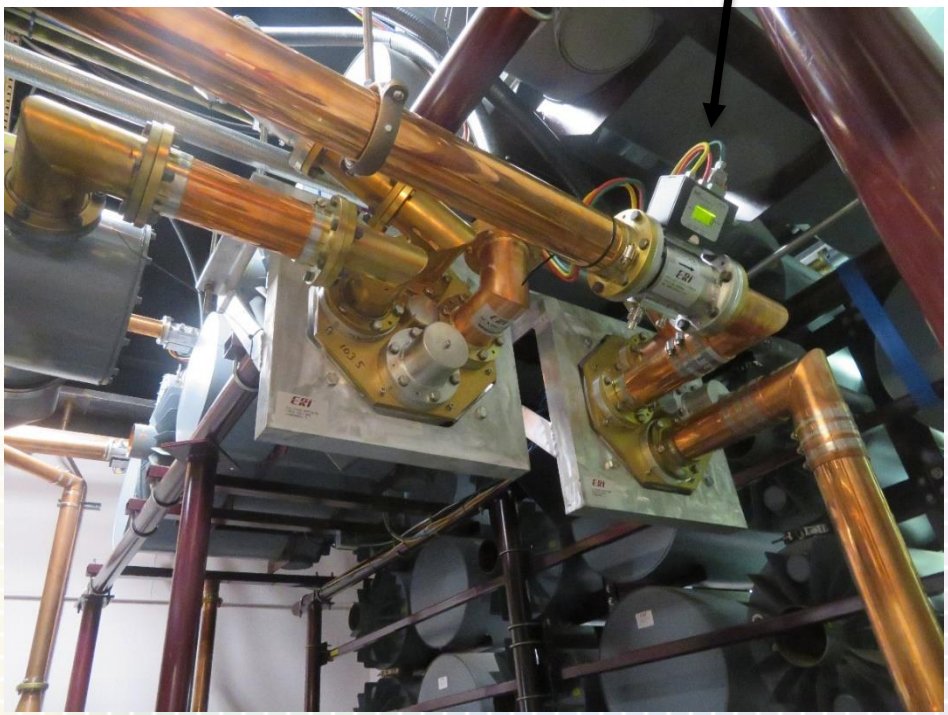
Vertically Racked Filters



Monitoring and Switching System

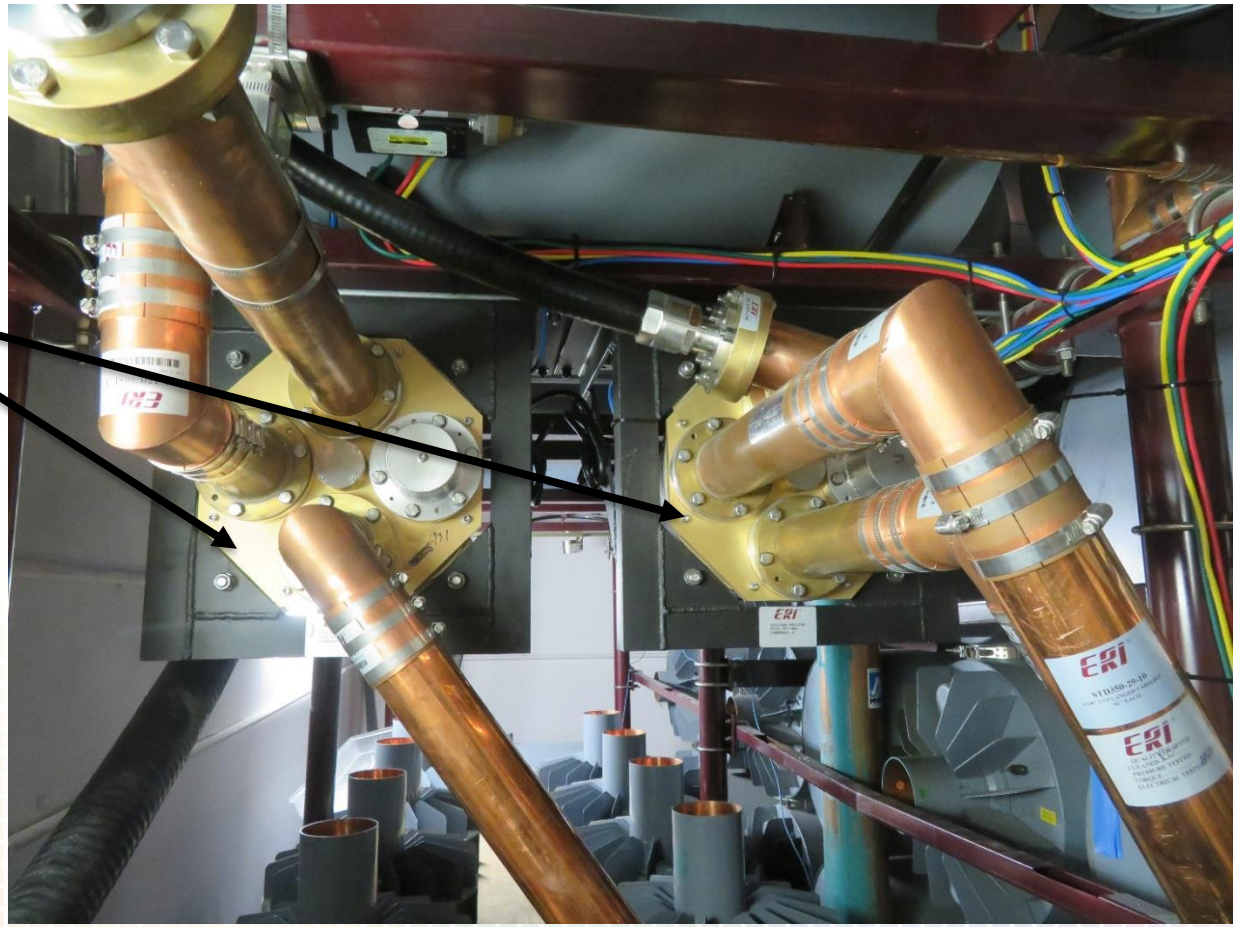
Automatic Switcher / Monitor

Monitoring



Switches

One per station



Project Management / Safety Coordination

- Safety / Project Management
  - BAWA – Broadcasting Area Work Authorization
    - Complete scope of work
    - Who / Where / When / Time table
    - Assess work areas
    - Provide site specific RF training and/or climbing rescue training
- Project Management
  - Permitting
    - Weekly work speeds
    - After hours permitting
    - Daily work reports
  - Coordinating shipment logistics
  - Many onsite visits
  - Weekly meetings