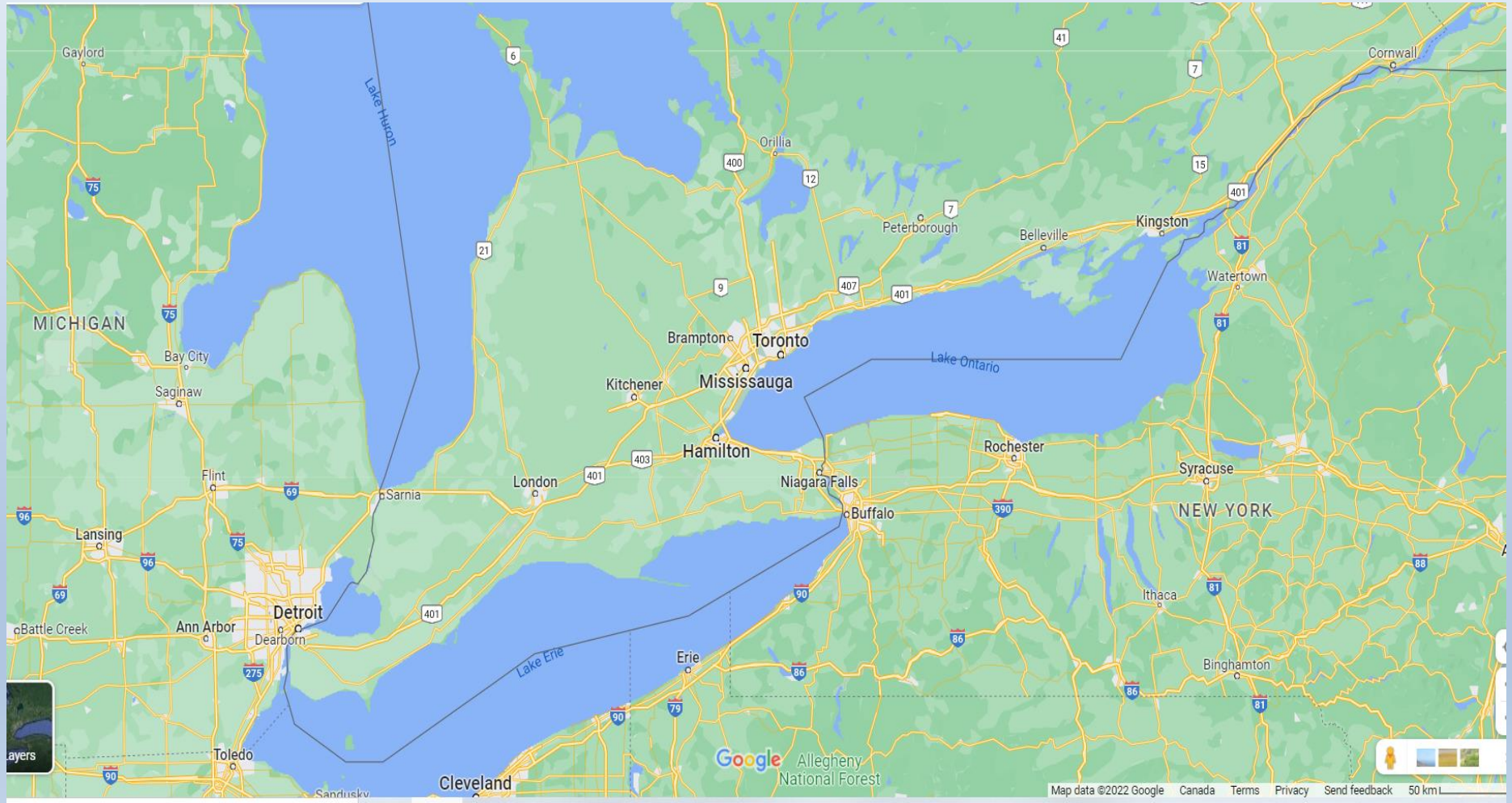
A LITTLE ABOUT VE3EJ BEFORE WE GET STARTED

VE3EJ

- First licensed 1972 – 50 year anniversary February 2022
- VE3AKG 1972 – 1979 - Queenston, ON
- VE6OU 1979 – 1985 – Sunnybrook near Edmonton, AB
- VE3OZU 1985 – 1990 - Grassie, ON (Near Grimsby)
- VE6OU/3 1985 – 1990 – Grassie, ON
- VE3EJ 1990 – present – Grassie, ON

- Contest and DX'peditions: FT5XO, VP8THU, VP8GEO, VP8ORK, VP8DEJ, HC8N, A61AJ, VP2E, 8P9EJ, WP2Z, PA9YI, K3LR, KC1XX
- WRTC: K6P, S581I, OJ5A, PT5M, R34C, N1M, Y89U
- Operated from: VE3UOW, PE2EVO, ZS5IAN, HC1OT, NP2X

Station location – Grassie, ON.



Original Farmhouse

Antennas at VE3EJ (6 towers) – 21 Yagis

- 160: Inverted vee @150 feet + 5 element parasitic vertical array
- 80/75: Inverted vee each 80 & 75 at 70 feet. 4 square verticals
- 60: Inverted Vee at 55 feet
- 40: 3 El yagi at 150 feet, 2 El yagi at 110 feet, Inverted Vee at 60 feet
- 30: Rotatable dipole at 70 feet
- 20: 5 El yagis 150, 100 and 50 feet. 6 El yagi at 110 feet
- 15: 5 El yagis 160, 120 and 80 feet. 7 El yagi 75 feet
- 10: 5 El yagis 160, 70, 40 feet. 8 El yagi 45 feet
- 6: 6 El yagi 75 feet, 7 El yagi 70 feet
- 2: 13 El yagi 80 feet, 4 El yagi at 40 feet
- Multiband: StepIR 4 El 60 feet + Optibeam OB16-3 60 feet

Looking South

160 Meter 3 Element Vertical Yagi at VE3EJ

Why, how, does it work and was it worth it?

Paul, K8PO (sk) was the inspiration for the project. After several contest operations at VE3EJ using a Delta loop and inverted Vee, Paul said: "you need to try a full size vertical".

And so the project began in 2004.

Paul, K8PO

Expectations

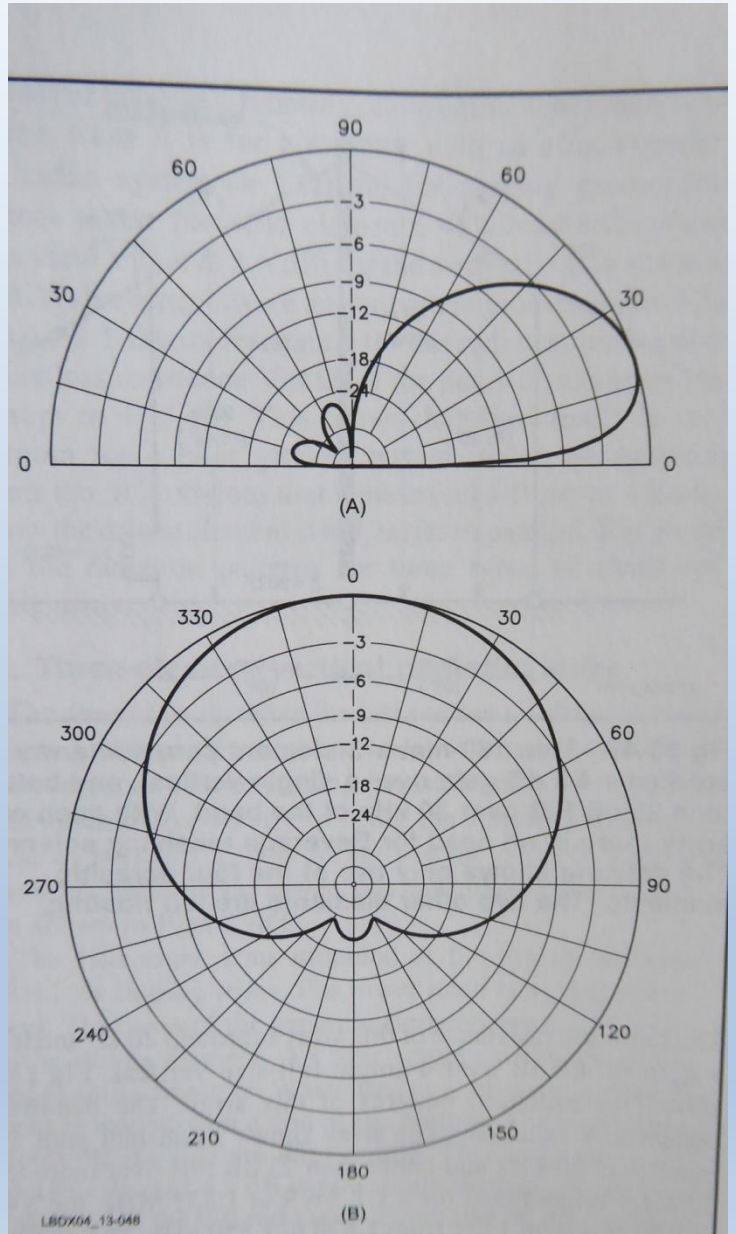
Single ¼ wave vertical

- Lower angle of radiation, more energy at critical elevation angles for DX.
- Polarization alternative to Inverted Vee.

3 Element vertical yagi

- 4.8 dB gain over single vertical.
- 20 dB front to back.
- Switchable directions (4) + Omni.

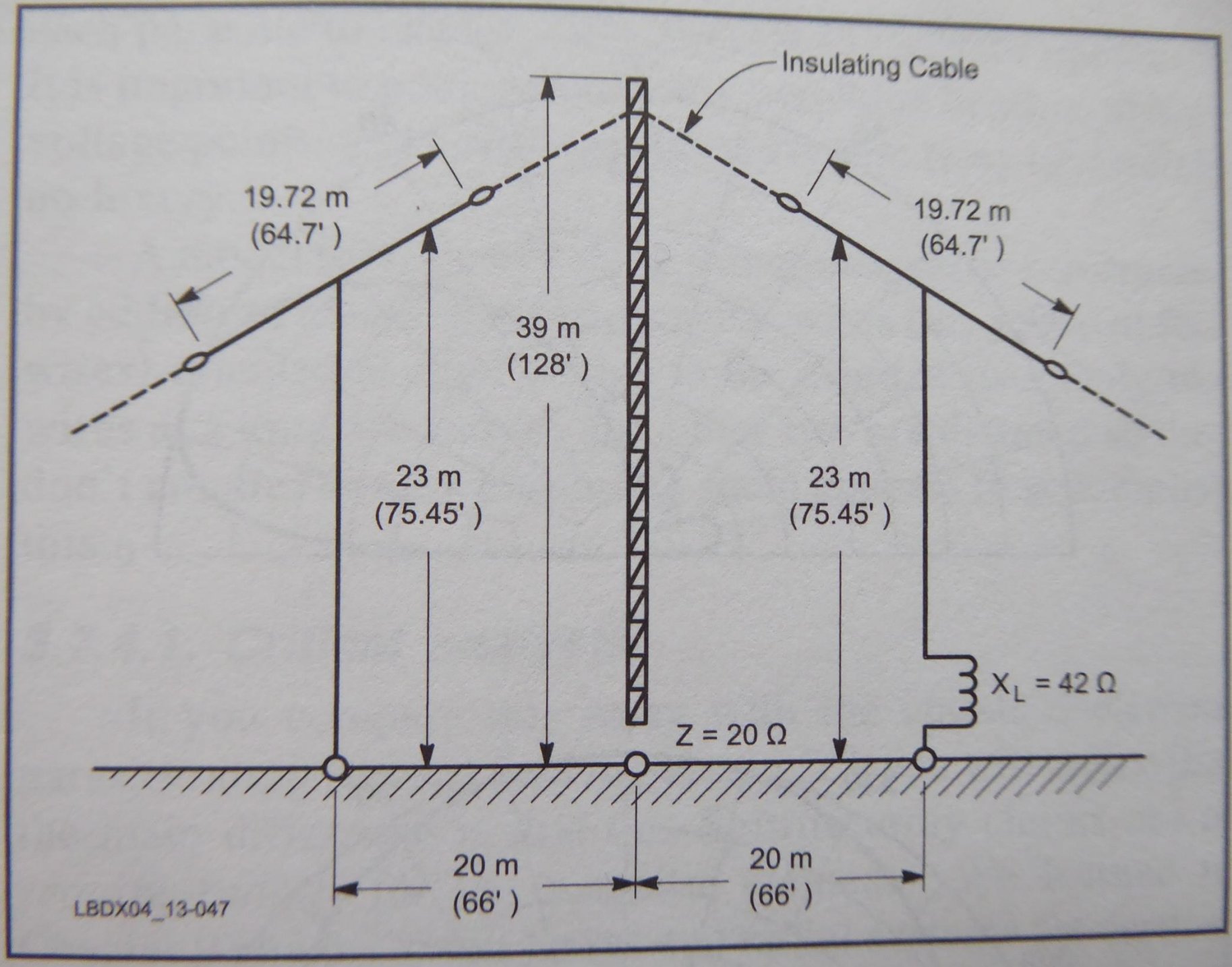
V & H patterns



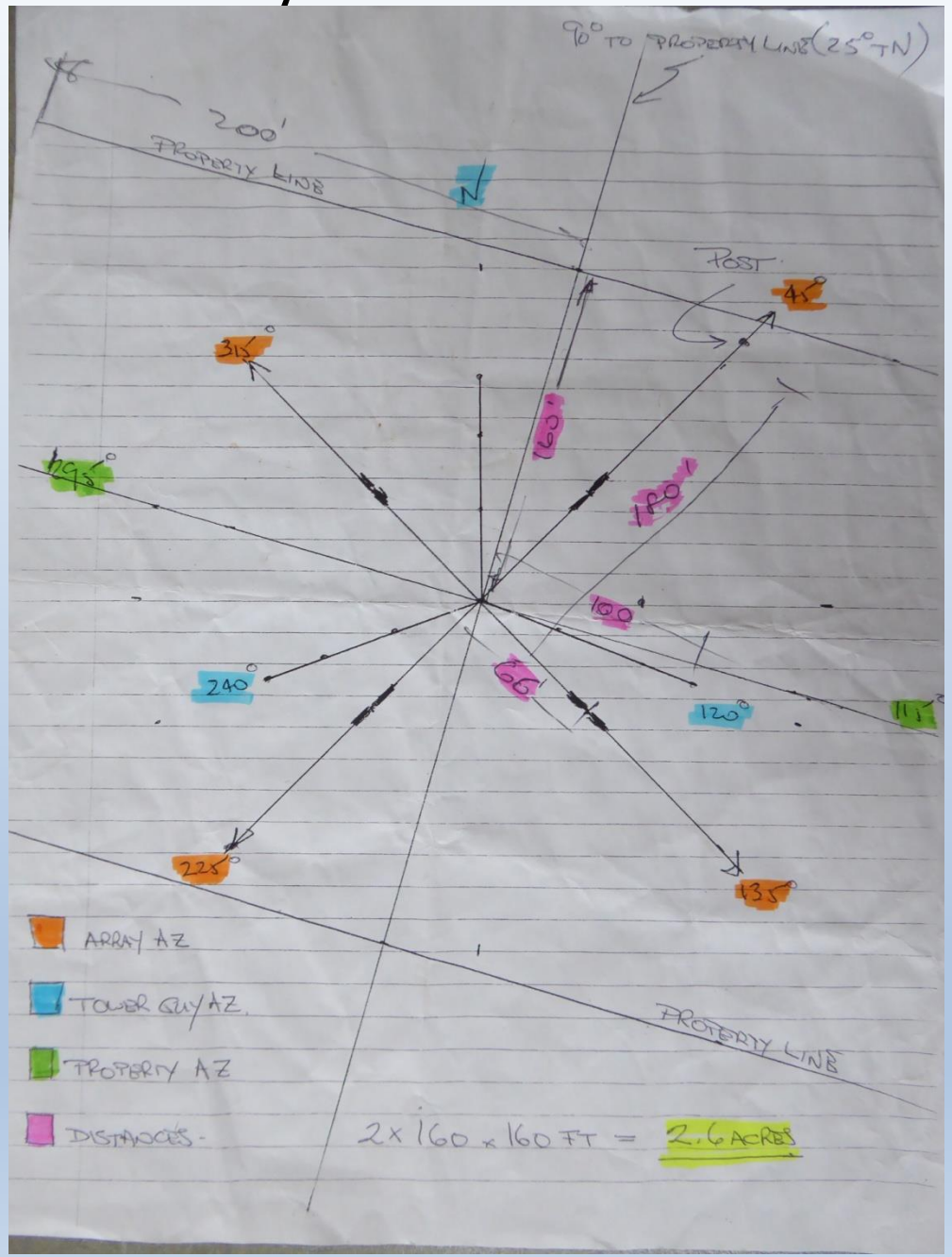
13-48—Horizontal and vertical radiation patterns for

Configuration

- Base insulated ¼ wave tower (130 feet).
- 4 quarter wave parasitic elements tuned as directors spaced 1/8 wave (67 feet) from center tower.
- Radials under each of 5 elements.
- Switch box at each parasitic element to add inductance to transform directors into reflectors.
- Matching unit (switchable) at base of tower.
- Control box for relay switching allowing 4 directions + omni.


Insulating Cable
19.72 m
(64.7')
19.72 m
(64.7')
39 m
(128')
23 m
(75.45')
23 m
(75.45')
X_L = 42 Ω
Z = 20 Ω
20 m
(66')
20 m
(66')
LBDX04_13-047

Physical dimensions.



Tower Erection

18 inch face width, solid round legs.

Support posts for parasitic element catenaries.

Concrete for foundations.

Base foundation and insulator + post for feed components.

The tower in two preassembled sections.

Crane in position

Final lift

130 feet of tower standing

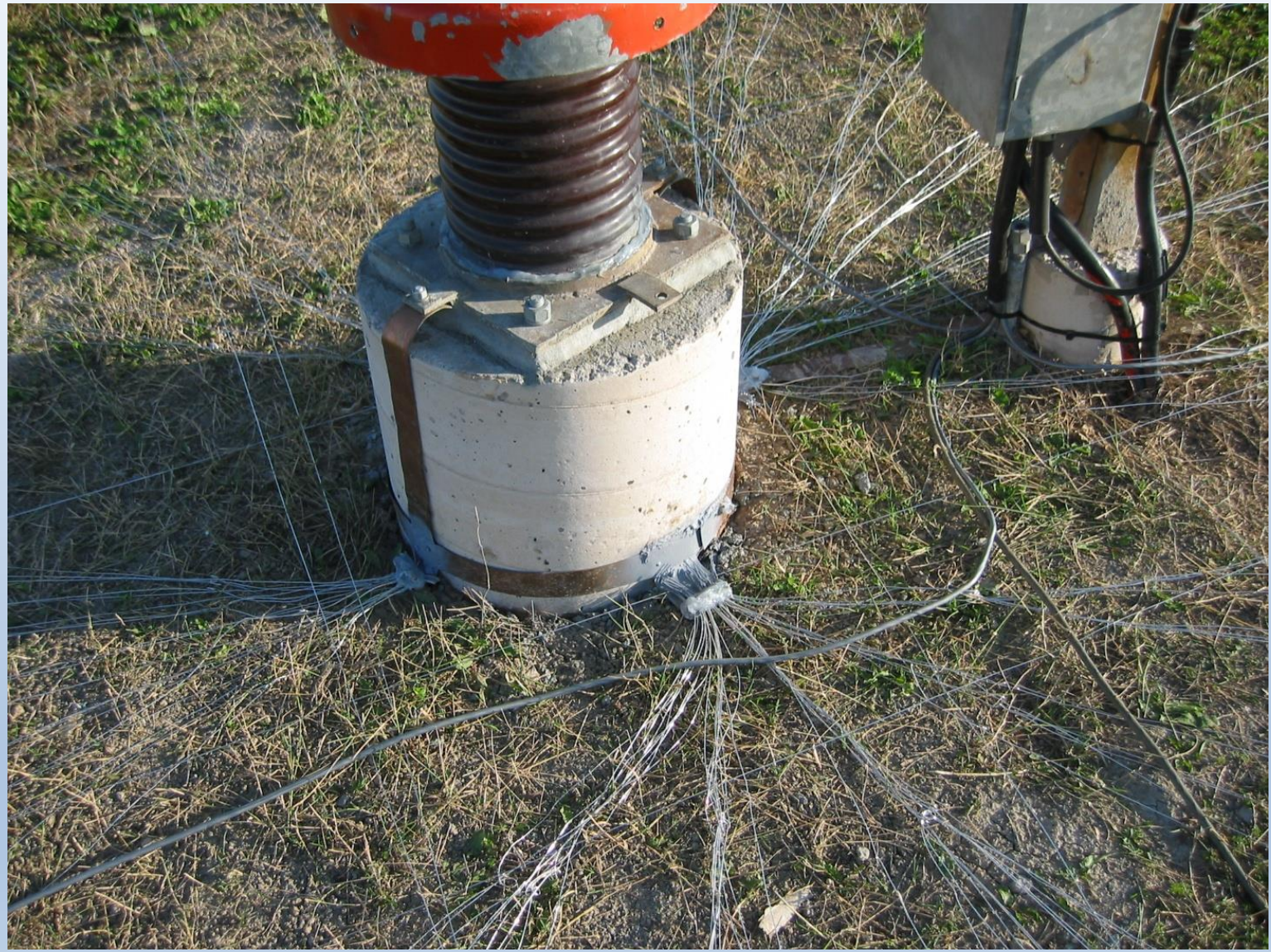
Radials

- Initially installed 60,000 feet of aluminum wire.
- 100 x 200 ft at base of tower.
- 100 x 100 ft at each parasitic element (4).
- Worked great for first season.
- Corrosion caused total failure at start of following season.
- Aluminum wires reattached and added about 30,000 feet of copper on top.

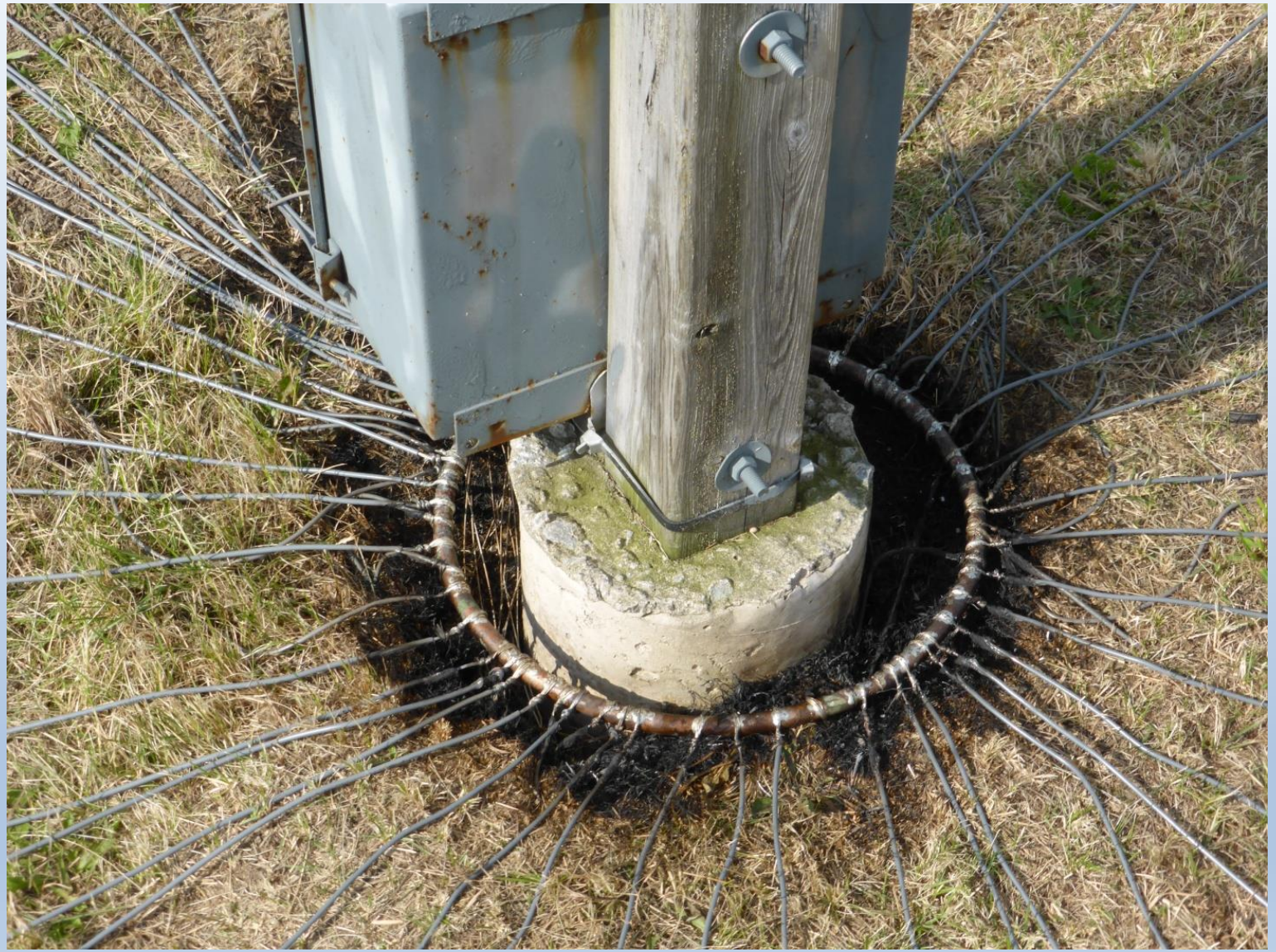
Original radials at base of tower

(Spaced 3.6 Degrees apart)

Original radials at tower base



New copper radials at parasitic element.



New radials at Tower base.

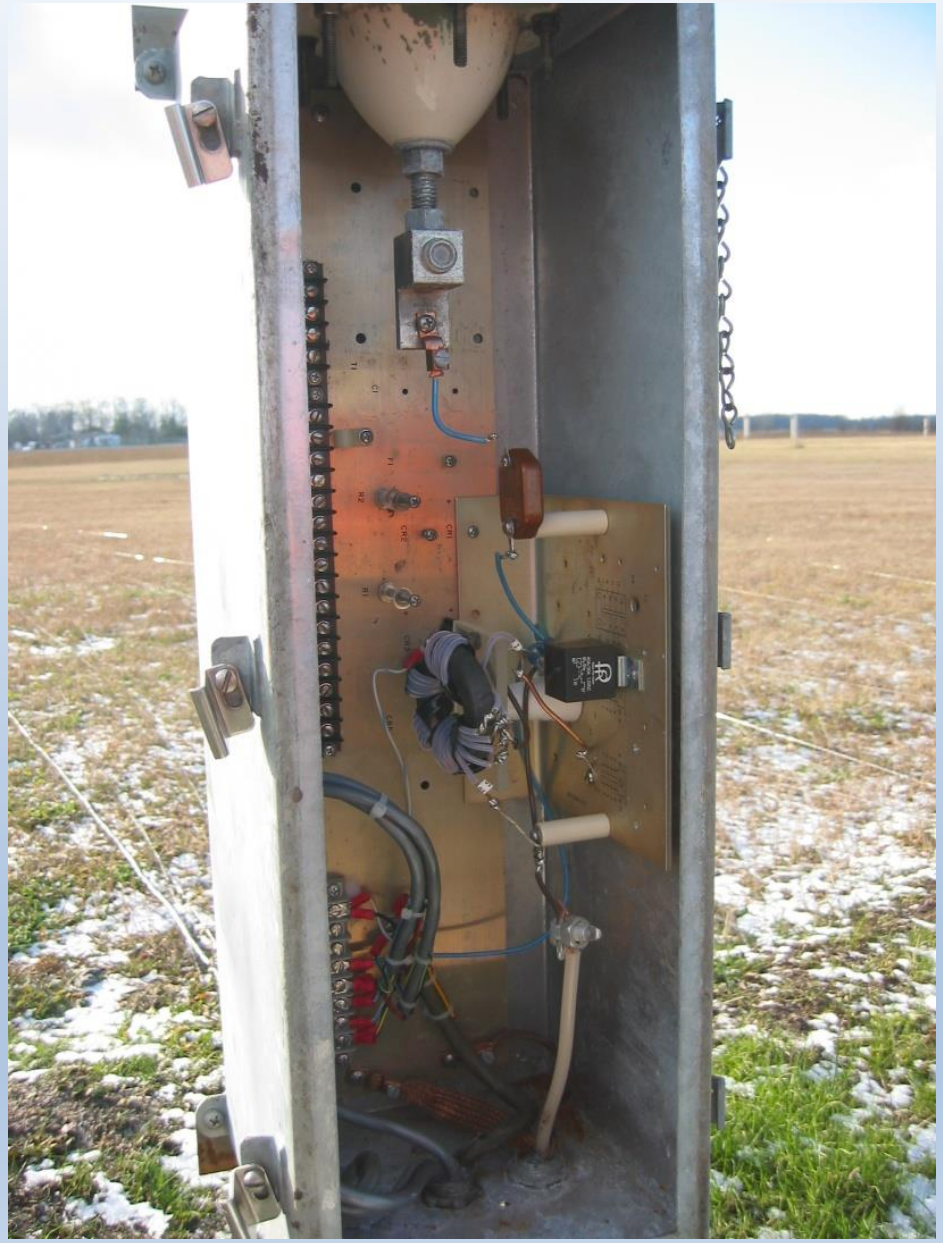
Catenary wire attachment at top of tower.

Catenary attachment at bottom end with counterweight.

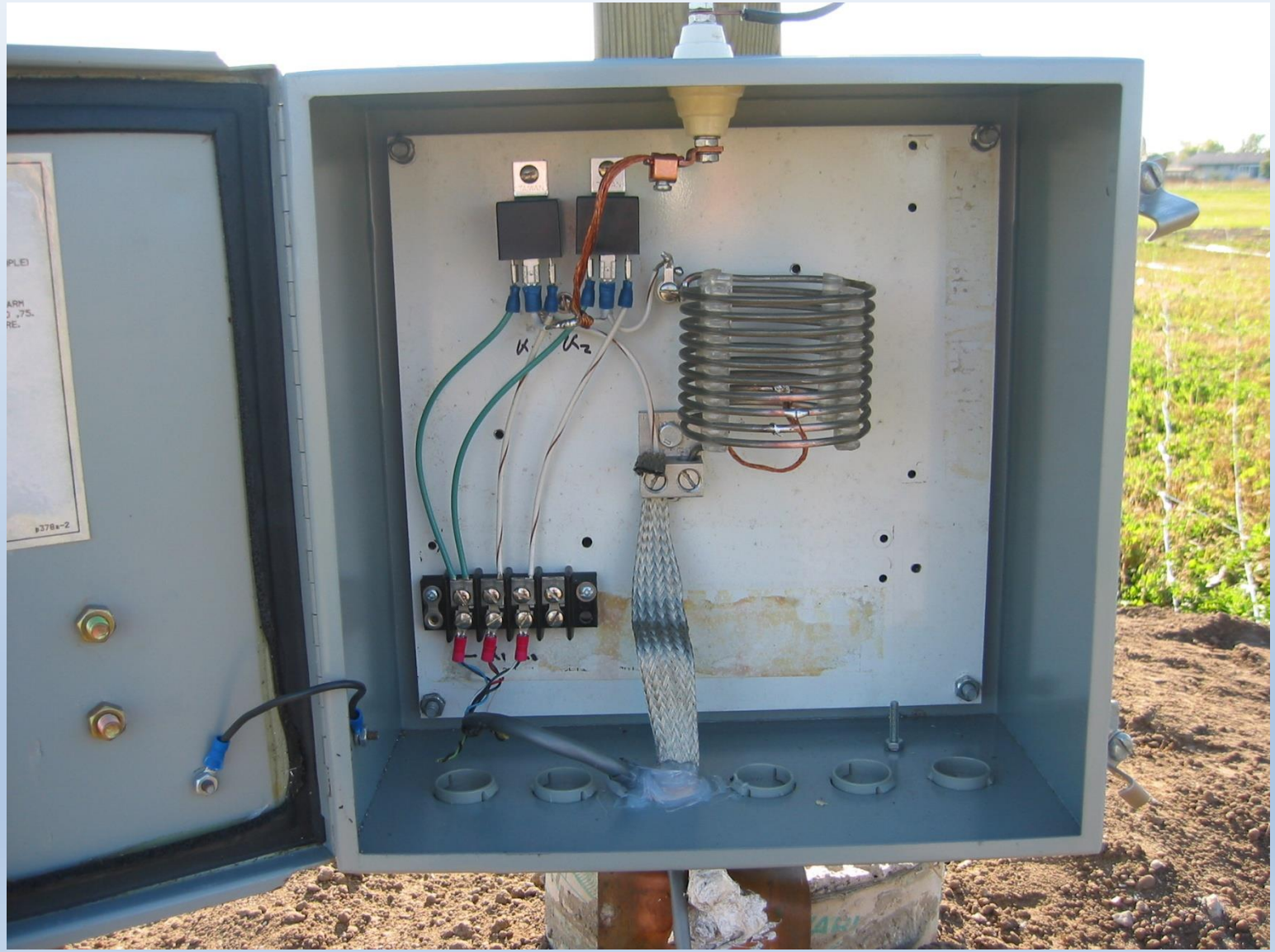
A little ice!

Counterweight doing its job!

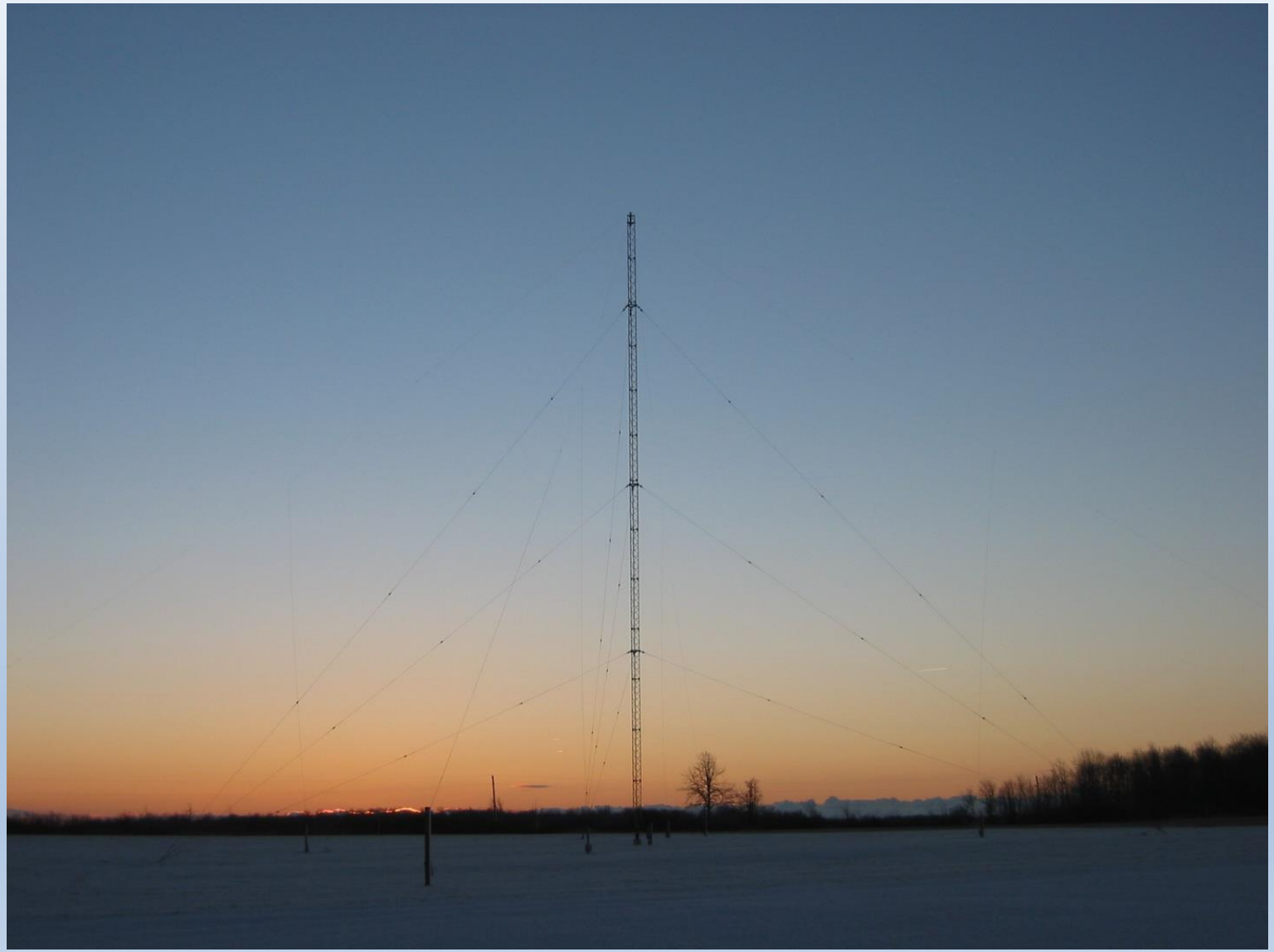
Junction/matching box.



Series inductor box at base of parasitic.



The array at sunrise in January.



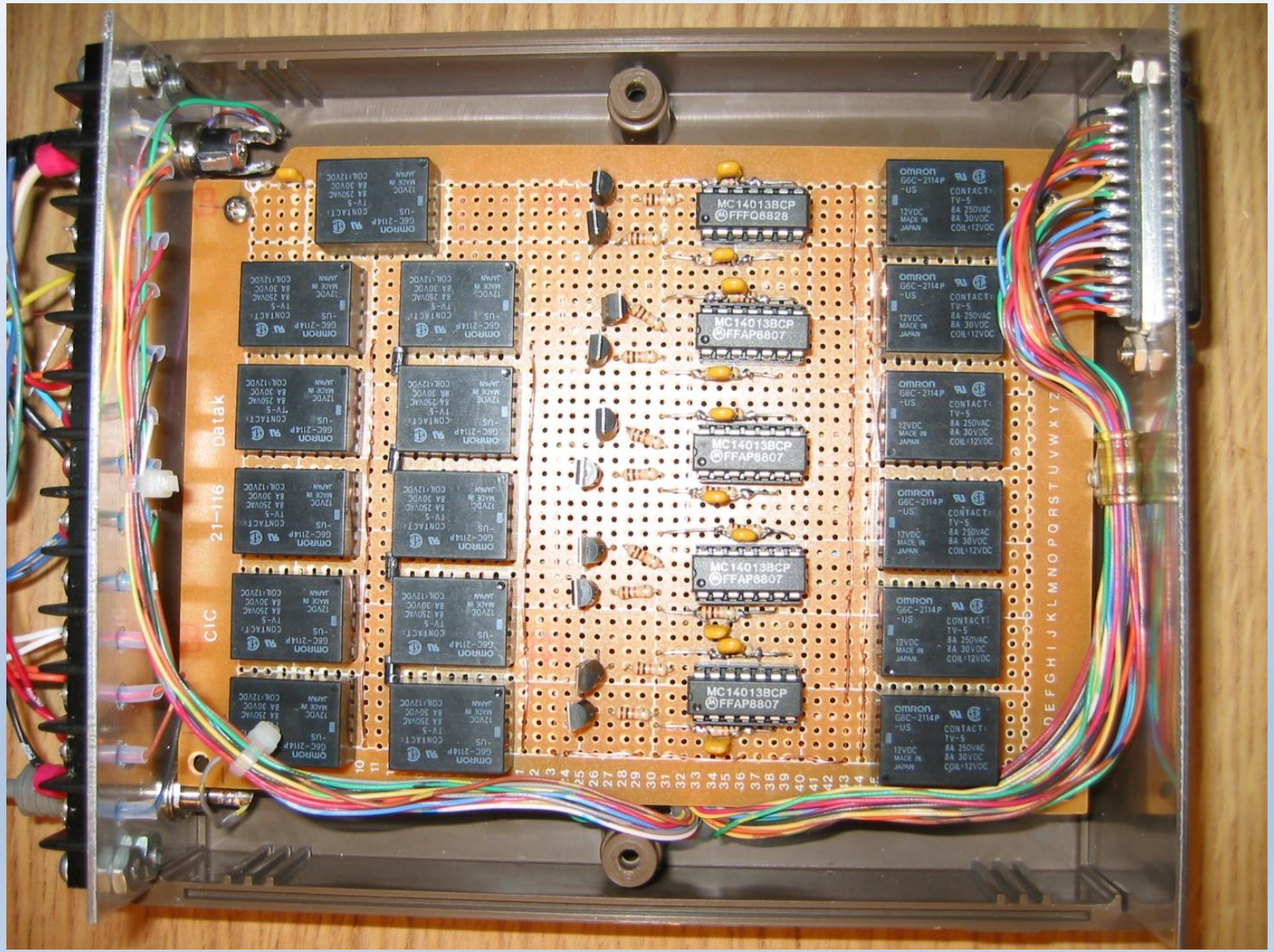
Direction Control System

- 5 Directions – NE/SE/SW/NW + Omni
- Option to tie RX direction to TX direction
- Hot switching interlock

Control and switching box

Direction Control Box

The working half



Tuning and adjustment

(Making it all come together)

Tuning parameters

- System center frequency 1830 KHz.
- Directors tuned to 5% (frequency) higher (1920 KHz.)
- Reflectors adjusted for best F/B.

Tuning the tower (Driven element)

- Parasitic elements need to be floating (no path to ground).
- Use impedance bridge or VNA to adjust physical length (pipe at top) or add either series L or C until there is no reactive component (pure R remains).
- Needed 2000pf series capacitor.
- R value should be a good indication of the quality of the radial (ground) system.
- Ideal ground will yield 36 Ohms for ¼ wave radiator.

Series Capacitor (Also arcing balls and static drain choke).

Parasitic wire length adjustment

- Adjust one at a time with tower and 3 other parasitics floating (no path to ground).
- Using Impedance bridge or VNA adjust physical wire length to produce resonance at 1920 KHz.
- Repeat on remaining parasitics.

Adjusting “L” value to produce reflectors.

- Ground parasitic in first direction (NE as example).
- Float SE and NW parasitics.
- Ground SW though best guess L Value. (3.7 uH)
- Drive tower (DE) with low level 1830 KHz signal.
- Measure signal level on receiver located straight line opposite direction to NE (SW). (.5 to 1 Km away)
- Adjust L value on SW element for minimum signal measured in SW direction. (best F/B value)
- Relocate RX to NE direction. Confirm that there is gain by comparing DE alone with parasitics floating vs NE grounded directly and SW grounded through “L”.
- Repeat on remaining 3 directions.

Results

- Gain – ¾ “S” unit – 4 to 5 dB over single vertical.
- Front to Back – 4 to 6 “S” units – 20 to 30 dB.
- Good symmetry in all 4 directions.

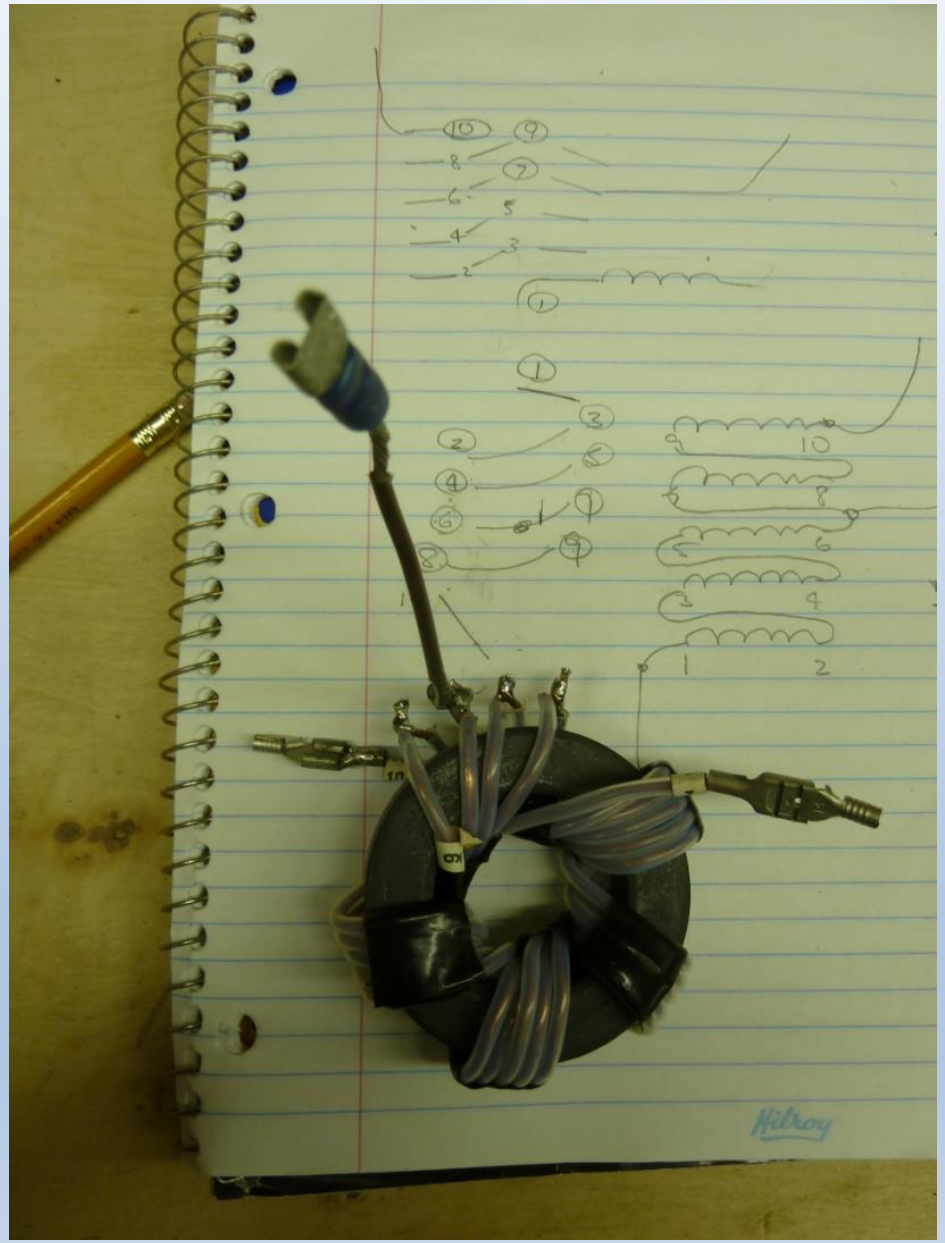
What about VSWR?

- Impedance of ¼ wave tower alone = 36 Ohms.
- Impedance of array goes down to 20 Ohms.

  - VSWR omni = 1.3:1 (acceptable).
  - VSWR directive = 2.5:1 (not acceptable).

- Need a matching device in directional mode.

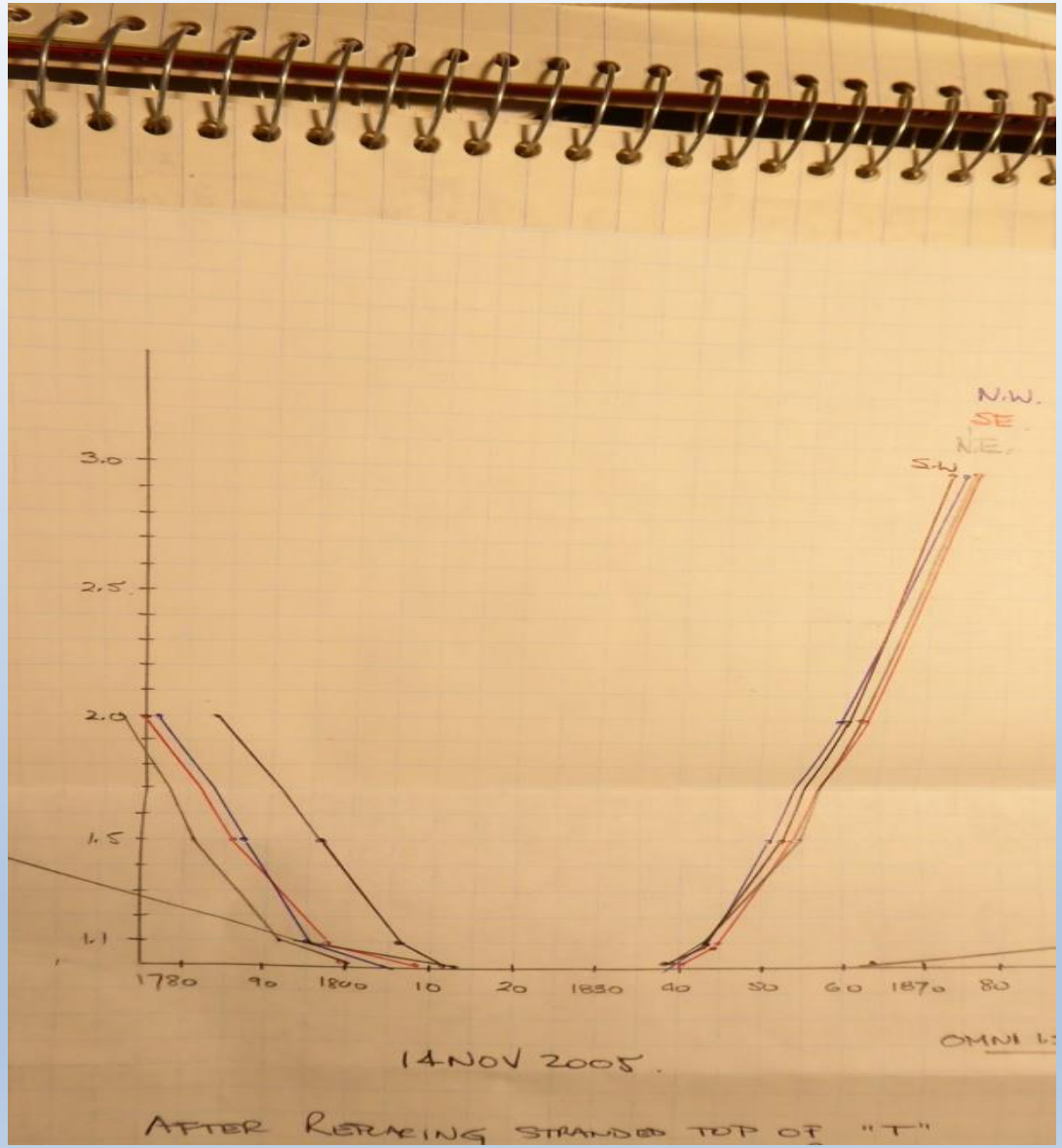
2:1 UNUN matching transformer



UNUN Details

- F240-61 Core
- 5 Turns of 5 windings (Quintufilar wound)
- Tap is 3 turns up form ground.
- Design: “W2FMI Transmission Line Transformers”

VSWR vs Frequency



VSWR vs Frequency

C/F = 1830 KHZ = 1.1:1 (All directions + Omni).

Omni:

- 1.5:1 VSWR = 1900 KHz + below the band.
- 2:1 VSWR = Above and below band edges.

Directional:

- 1.5:1 VSWR = 1853 KHz + below the band.
- 2:1 VSWR = 1861 KHz + below the band.

Results – Was it worth the effort?

Results:

- Generally always feel strong on the band.
- Almost no need for RX antennas.

- Over 100,000 QSO's on 160 since 2004
- 307 DXCC Countries confirmed
- WAZ all 40 Zones – JT1CO was last for Z23 in 2010
- Lots of fun on 160

- **Was it worth the effort?**

YES!

Acknowledgements

- K3LR – Tim Duffy – Original design
- W3YQ – Tim Jellison - Switching design
- ON4UN's Lowband DXing Handbook - construction notes and illustrations.

Thank you and see you in the contest (or pile-up)!

73,

John, VE3EJ