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Report from EOC HF antenna work on 5/14/2019

Ryan Lee was extremely gracious to work with me and Larry Rovak (who had to leave around 11 or so) – Ryan and I worked from 9 until about 1 PM and made multiple tests. The results-- and some tentative opinions not reviewed yet by any of you – are presented below.

1. The **reflectometer** showed the cable to be approximately 131 feet and did not show any unexpected discontinuities.

2. A quickly measured **SWR curve** every MHz from 3 to 15 showed the response was similar to what we have seen before.

3. **Un-Un Balun ("isolator"):** We measured the noise directly from the antenna (no tuner) in the 80 meter region and it was -60 dBm @ 3.5 MHz – and was unchanged by adding a **un-un balun**. (I do not know what the bandwidth of that measurement was, unfortunately).

4. A considerable amount of work was done to **verify the physical continuity of the HF cable from the radio room literally to the Balun on the roof.** There were the usual confusion issues and one connector that was a bit "iffy" which Ryan fixed. We were in the end able to verify connectivity all the way: using a shorting wire, we verified from the radio room to the position of the Polyphaser in a locked computer room, and from the antenna end, with a 50 ohm load down on the cable end near the polyphaser we measured 50 ohms and a perfect SWR well past 70 MHz.

REMEMBER that polyphasers have a series capacitor – which is why we measured an open circuit across the coax in the radio room.

5. We **measured the SWR again right at the antenna** – which was only 5 feet off the roof due to some stretching – using only a 2 foot 50 ohm interconnection cable to avoid transmission line effects. The result shows that the SWR measured down in the radio room is "better than it really is" (likely due to losses in the cable run with really high swr's). Right at the antenna, you can measure the IMPEDANCE, but my antenna analyzer knows only the absolute value of the reactive portion (it doesn't know whether inductive or capacitive). In the following table I show the measurements at the Antenna and at the radio room (where the impedance was not measured because it would have transmission line changes)

FREQ (MHz)	Impedance at antenna	SWR at antenna	SWR at radio room*
3	0 (real)/22 j	20	3.8

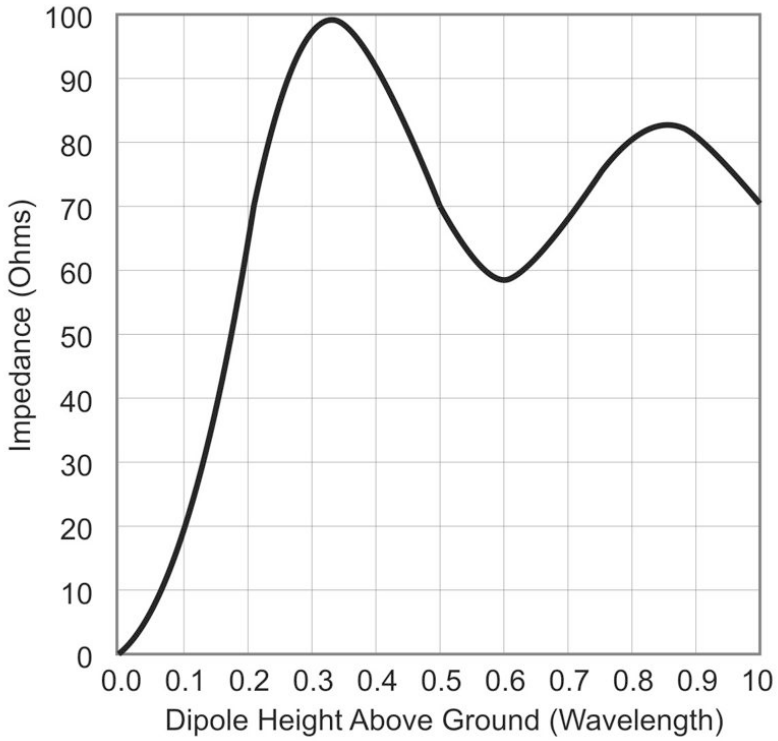
4	44 / 152j	10.5	7.8
5	7/ 71 j	8.8	5.3
6	6/22j	5	5.5
7	84/23j	2.3	5
8	28/80j	8.8	4
9	1/48j	11.4	6.5
10	0/30j	13.1	3
11	0/17j	11.7	4
12	1/6j	11.7	4
13	7/14j	6.8	1.2
14	31/5j	1.6	3
15			1.2

* re-interpreted from a graph I had constructed

COMMENTS:

1) NOTICE WHAT A DIFFERENCE BEING ON THE FAR END OF A 130 FOOT CABLE MAKES!!!

2) In general, these impedances suggest that the antenna is generally showing a much LOWER impedance than expected. The off center buckmaster at the wire ends is hoped to show 200 ohms, which is then reduced 4:1 to 50 ohm, a nice match. In our case, what is coming out is much lower than 50 ohms most of the time. It is known that antennas which are close to a GROUND will have lower impedance.



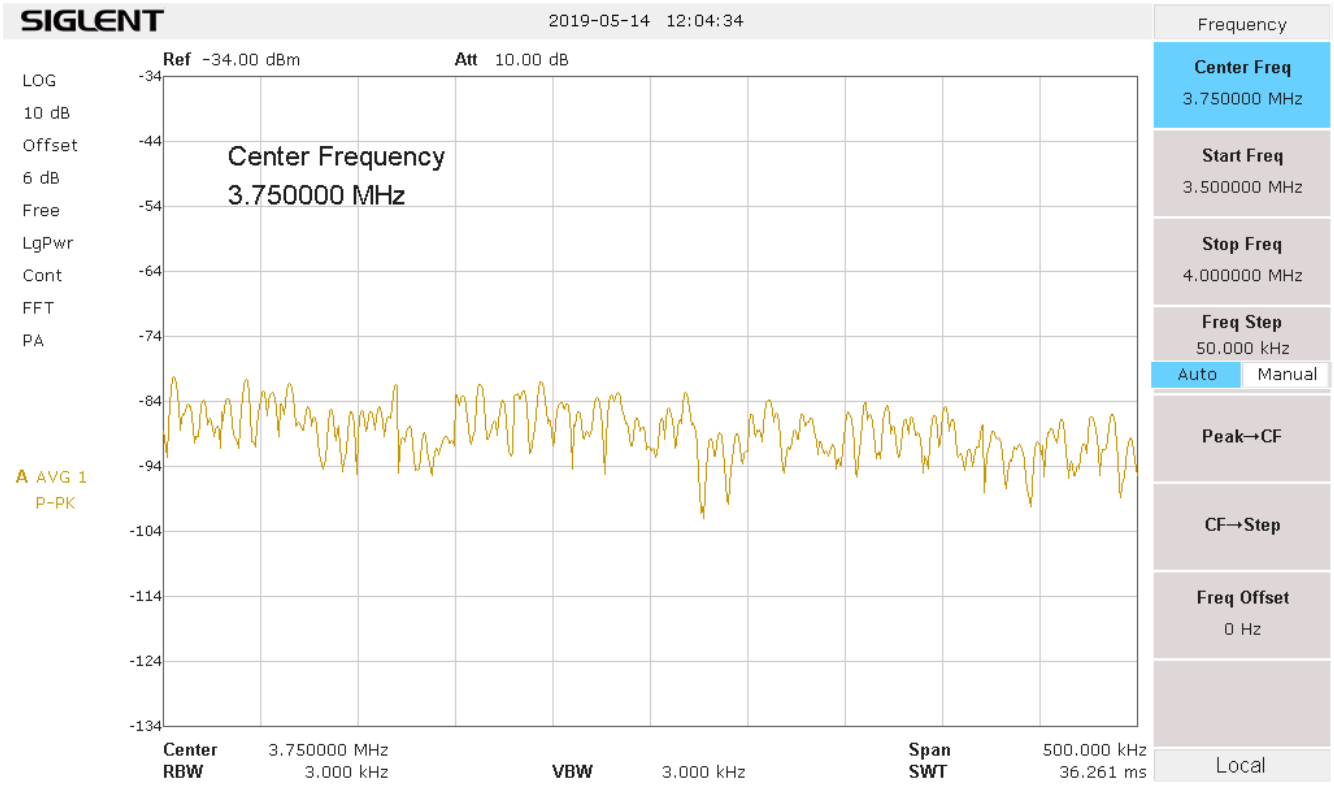
REFERENCE: http://www.hamradioschool.com/wp-content/uploads/2015/07/dipole-impedance.jpg

So it is likely that the relative closeness to the roof, its metal, its grounding wires and lightning rods, is causing the antenna to have an unwanted low impedance. The manufacturer requests the antenna be placed significantly above ground.

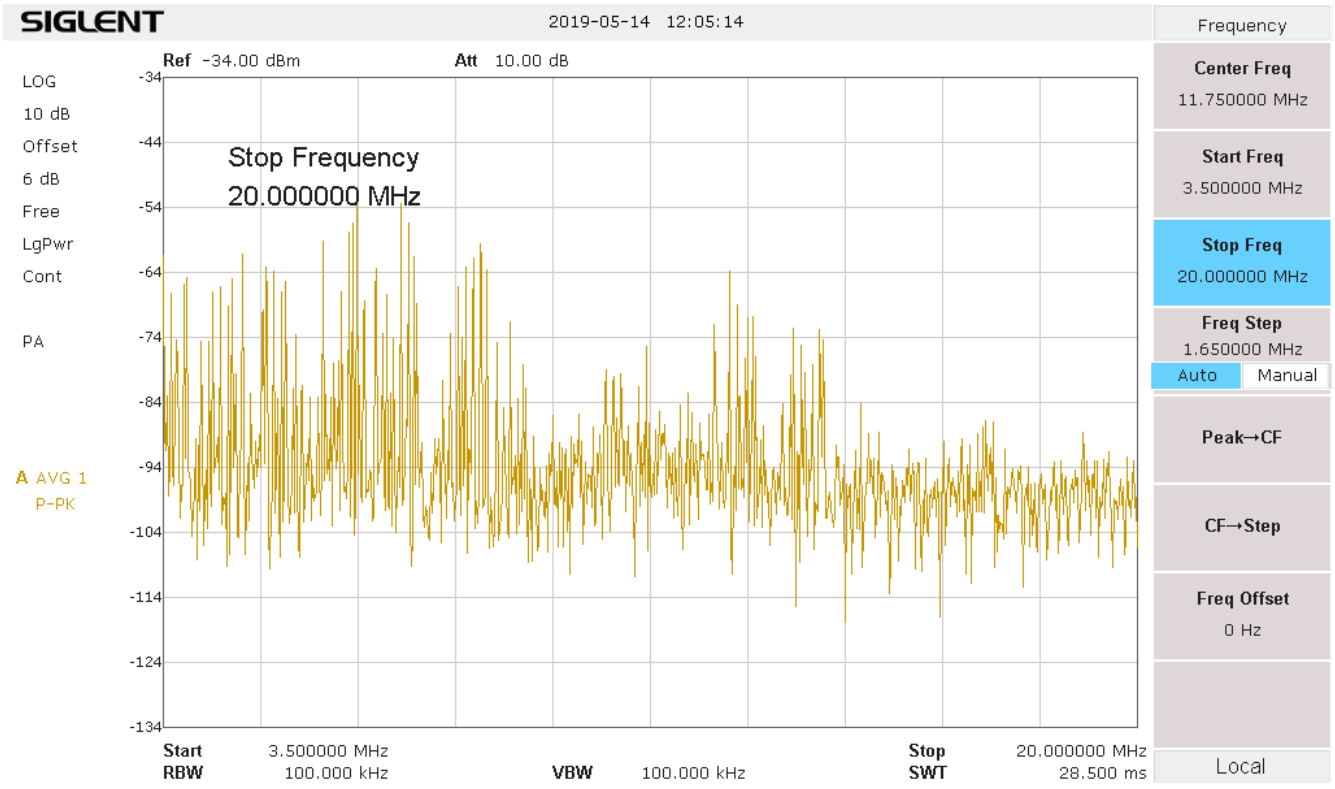
6. Since we have already demonstrated that the ambient RF signals in the EOC building are some 15+ dB stronger (using a small exploring 2 foot dipole antenna) than those at the Gibby household, in the range of 3-8 MHz, it seemed that it was a good idea to **see what the field strengths above the roof were…** If there are strong field strengths picked up by a 2 foot antenna, then one would surmise that a 130 foot antenna might pick up strong signals also, leading to the very strong noise signal that we have already documented on the EOC antenna (through a tuner) here: https://qsl.net/nf4ac/2019/EOCResults04232019/EOCAntennacs40mtune.jpg

Using the same settings, but adding a section of 50 ohm coax for length (which should not affect readings too greatly at the low MHz range we are using) Ryan climbed up to the roof and held the 2-foot probing antenna a few feet above the roof, while I stayed on firm concrete floor below with the expensive spectrum analyzer.

Measurements were made 3.5-4 MHz (3 kHz bandwidth) and 3-20 MHz (100 kHz bandwidth). The signal powers reported should be correct in dBm:



The 3.5-4 MHz plot above shows noise in the range of -84 to -94 dBM (3 kHz bandwidth).



This 3.5-20 MHz plot was done with a 100 kHz wide filter. For wide band noise, (not for narrow noise) the total noise in a bandwidth is equal to the noise density + a correction for the bandwidth. IF this were wide band noise, the correction for 100 kHz filter width (versus 3kHz for typical ham radio) would reduce the noise by 15dBm. I don't know if these noise signals seen above are wide band (they don't look like they are) but even giving them the benefit of the doubt and subtracting 15dBM you have signals picked up by a 2 foot dipole that are as strong as -60 dBm – 15dBm = -75 dBm.

At my house the WINLINK ham antenna is right outside my 2nd floor, where the same antenna picked up signals of roughly -110 dBM [and the ham antenna would be expected to pick up those same signals]

– which is 26 dB louder than the signals picked up on the roof of the EOC in the 80 meter band at 3kHz bandwidth
– and 35 dB louder than the signals picked up on the 2nd sweep (3.5-20MHz) even when corrected for noise bandwidth.

First Cut Unreviewed Opinion
In other words you can make that antenna a better TRANSMITTER antenna with better impedances and better matching and that is probably a good idea, BUT No matter how much you improve the receiving antenna at the current EOC roof top location, you are going to be 25 to 35 dB MORE DEAF than my station at my house. If I can just barely hear a station running 10 watts….you will just barely be able to hear a station running 10 THOUSAND watts.

We probably need to consider what the implications are of these findings for means of reaching the State EOC-- or other EOC's – by long distance HF, either Ham or SHARES – at the EOC.

One suggestion, mentioned before, is to simply put a **simple receiving antenna** a few hundred yards AWAY from the near-field of the noise sources at the EOC (it could be passively hard-connected with balanced line for $100 or so) – using the EOC antenna for TRANSMITTING. There are other solutions, but that is one. And as the EOC may be moving at some point in the future – we need to consider options. These kinds of findings may be an important clue for other EOC's and their HF ham radio or SHARES communications….