



Ham Hum

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THE TUNING OF A DUPLEXER

A Saga of Suspense, Intrigue, Discovery, and Accomplishment

By John WB0CMC and Paul WB0GXD

While troubleshooting a noise issue on the 146.82 SWIARC repeater it was determined that the duplexer needed to be serviced. John WB0CMC volunteered to look it over if it were transported to his workbench. Anxious to take advantage of this generous offer, the duplexer was removed from the 82 site and conveyed to John's inner sanctum. You can see the duplexer set at the bottom center of photo 'A'.



Photo 'A' - John WB0CMC at his workbench. SWIARC duplexer visible at bottom center of photo.

A word here about the type of duplexer we are working on for this article. It is a Band-Pass / Band-Reject style duplexer. It usually consists of two cavities in both the transmit and receive leg tuned to pass one frequency and notch, or reject, the other frequency. The transmit leg is tuned to pass the transmit frequency and notch the receive frequency; while the receive leg is tuned to pass the receive frequency and reject the transmit frequency. Illustration 'B' is a spectrum analyzer display of a typical single cavity band pass / band reject filter. The "band pass" portion of the cavity is tuned to 155 MHz and shows approximately a 1 dB insertion loss. The "band reject" portion of the same cavity shows either a 27 or a 32 dB insertion loss, depending on which curve you are looking at.

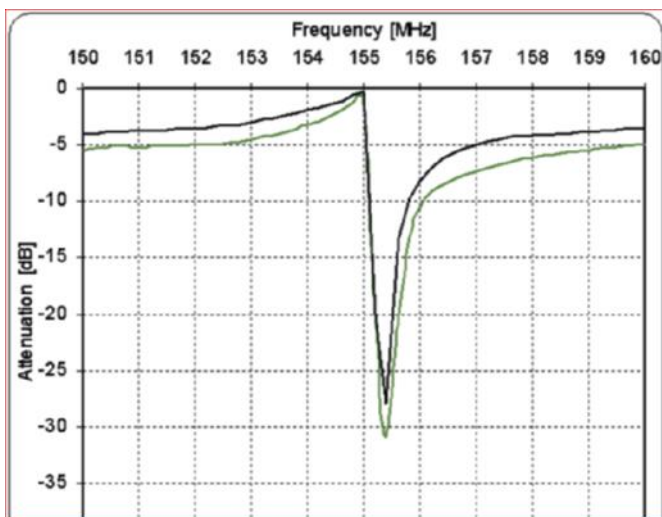


Illustration 'B' - A spectrum analyzer display of a typical single cavity band pass / band reject filter.

John went to work and set up his spectrum analyzer, sweep generator, and marker generator. After the test equipment was ready the duplexer receive leg (both cavities) was attached, with the sweep analyzer feeding into the receiver port and the sweep generator attached to the antenna port. Photo 'C' shows the curve of the SWIARC duplexer receive leg as it was when we started.

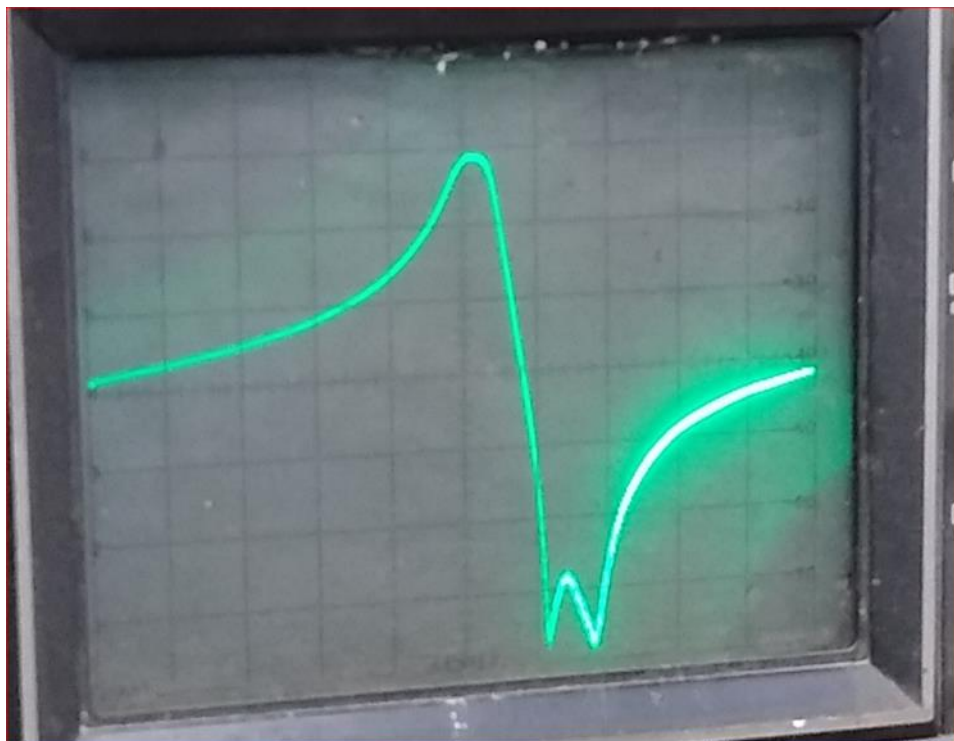


Photo 'C' shows the curve of the SWIARC duplexer receive leg as it was when we started. ..Note the double notch on the right.

The peak on the left is the 146.22 receiver frequency that is passed through from the antenna port to the repeater receiver. The double notch on the right is supposed to be a single notch tuned to the 146.82 transmitter frequency. Each major graticule division is 10 dB, so the two notches are only about 66 dB down. The specification for this duplexer is 80 dB. The double notch occurs because the notch tuning on the two cavities don't match. Each is notching at a slightly different frequency.

The test equipment was then connected to the duplexer with the generator attached to the transmit port and with the sweep analyzer attached to the antenna port. Photo 'D' shows the curve of the SWIARC duplexer transmit leg as it was when we started.

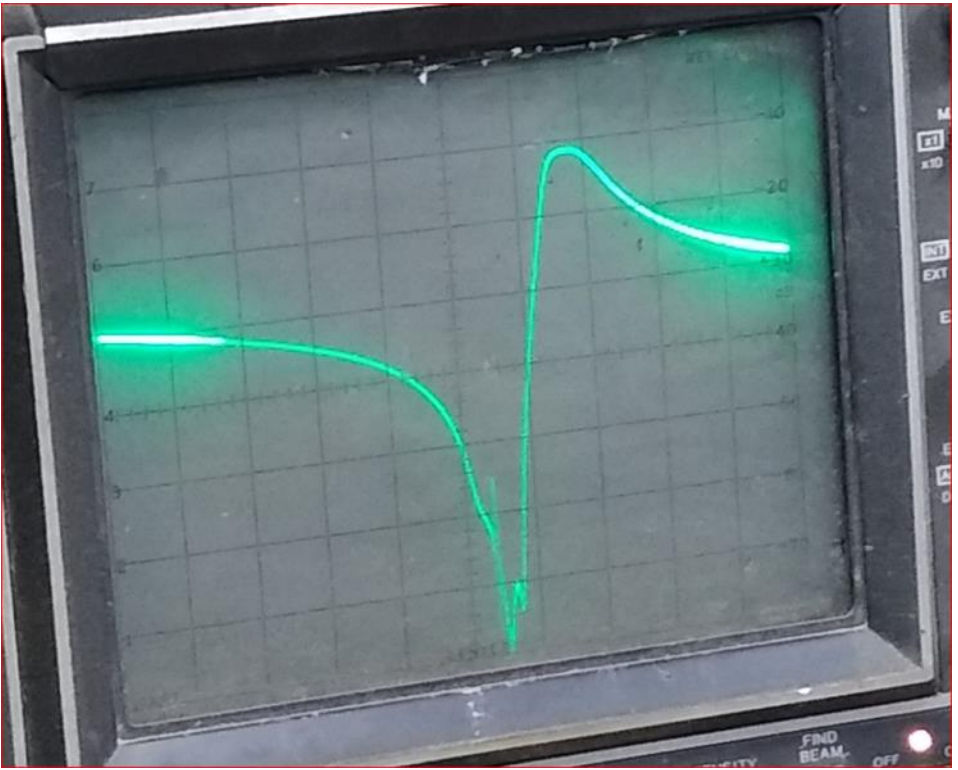


Photo 'D' shows the curve of the SWIARC duplexer transmit leg as it was when we started.....Note the abnormal notch on the left.

The little upward spike seen within the notch dip is the external marker generator used to mark the 146.22 MHz frequency within the display (labeled 146.22 MARKER in the photo). Again, you can see the double notch where the two duplexer cavities' notch filters are not tuned to the same frequency. In fact, neither of the two notches are on the 146.22 MHz frequency. 146.22 MHz is only about -55 dB instead of the -80 dB spec.

At this point, the duplexer was re-tuned to factory specifications or better. The transmit leg measured about 1.2 dB insertion loss on 146.82 MHz with a notch of -85 dB of rejection on 146.22 MHz. The receive leg measured about 1.4 dB insertion loss on 146.22 MHz with a notch of -83 dB of rejection on 146.82 MHz.

The SWIARC Yaesu Vertex RF deck was attached to the duplexer's transmit and receive ports, and the antenna port was attached to a dummy load. Wattmeter readings showed about six watts out of the vertex into the duplexer, and about 4 watts out of the duplexer to the dummy load. No discernable desense could be detected.

Suddenly, with no apparent provocation, the wattmeter dropped from 4 to 0.5 watts and the spectrum analyzer showed a large amount of broadband RF noise across to width of the display. After about 30 seconds the noise cleared and the power output returned to normal. This is not a good development. This indicates some type of intermittent problem, and it needed to be resolved.

With the transmitter keyed up and all was working fine, we began wiggling cables, tapping on the various parts of the duplexer and in general trying to get the problem to reappear. Try as we might, we couldn't get the problem to surface again. As we sat in suspense, discussing the situation, suddenly the problem returned. Again, we wiggled cables, tapped on the various parts of the duplexer and in general tried to get the problem to clear. No luck. Hmmm... Intriguing...

While the problem was still present, we started chasing the transmitter power loss through the system. This was accomplished by starting at the receiver port. Disconnecting the receiver at the duplexer had no effect, the problem remained. Re-attaching the receiver to the duplexer and disconnecting the cable connecting one cavity to the next also had no effect. This process continued until the receive leg was cleared. Then we started on the transmit leg, moving the wattmeter from the antenna port directly to each cavity in the transmit leg. While this was being completed the problem cleared.

While we were still intrigued as to what was causing the problem, we knew it was definitely in the duplexer cavities in the transmit leg. The next step was to check the insertion loops for the cavities. This is the part of each cavity where the signal is inserted into the cavity, and is where the cables attach to the cavity. Messing with the insertion loops is not for the faint at heart and should not be attempted unless necessary.

When the first insertion loop was removed and inspected under magnification it was discovered that the capacitor across the terminals was positioned extremely close to the metal strap. The capacitor being discussed is the 'Z' shaped component with the gray plastic material separating the metal plates. The bottom of that component is positioned with no discernable clearance to the naked eye. It is so close that a piece of paper wouldn't fit in between them. See photo 'E'.



Photo 'E' - This photo shows the insertion loop with the Z-shaped capacitor almost touching the strap. ..No space between them can be seen. The small trimming capacitor behind it is the notch adjustment.

Some minor physical tweaking increased the space from the bottom of the capacitor to approximately $1/32''$. There was also an extremely small solder splash inside the loop that was removed. Photo 'F' shows one of these insertion loops after it has been adjusted. The space between the bottom of the capacitor and the strap can now clearly be seen. The insertion loop was then re-installed into the cavity.

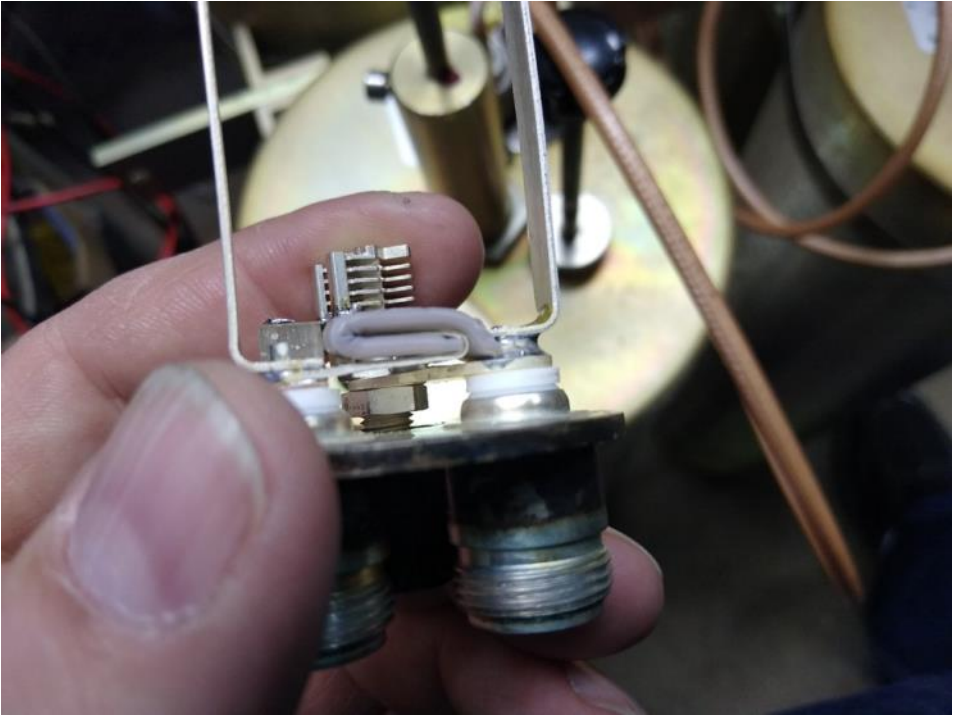


Photo 'F' - The space between the bottom of the 'Z' shaped capacitor and the strap can now clearly be seen

The insertion loop for the next cavity in that leg was next. After it was removed and inspected, the same problem was evident. The 'Z' shaped capacitor on the second insertion loop was also extremely close to the metal strap. The same physical adjustment was made to this second insertion loop and it was then re-installed into its cavity.

After the duplexer connections were all made 'normal', the duplexer was again connected to the sweep generator and spectrum analyzer. The tuning process as described at the beginning of this article was repeated, both for the transmit and receive legs of the duplexer. Again, factory specs were achieved.

After re-tuning, the Yaesu Vertex RF deck was again attached to the duplexer's transmit and receive ports, and the dummy load attached to the antenna port. Extensive testing began, including wiggling cables, tapping on the various parts of the duplexer and in general trying to get the problem to reappear. The problem never returned. The wattmeter held steady at its approximately 4 watts output with no desense.

After discovering a problem that had been present since its manufacture at the factory, we had accomplished repairs and were able to return the duplexer to service on the SWIARC 146.82 MHz repeater the same day, confident that there is no problem with it.

For those that have always wondered what the inside of one of these cavities looks like, photo 'G' page 9 is a view of the inside of a cavity that was visible with the insertion loop removed. There is a shorter tuning rod the is not visible in this photo as its view is blocked by the large tuning rod seen here.

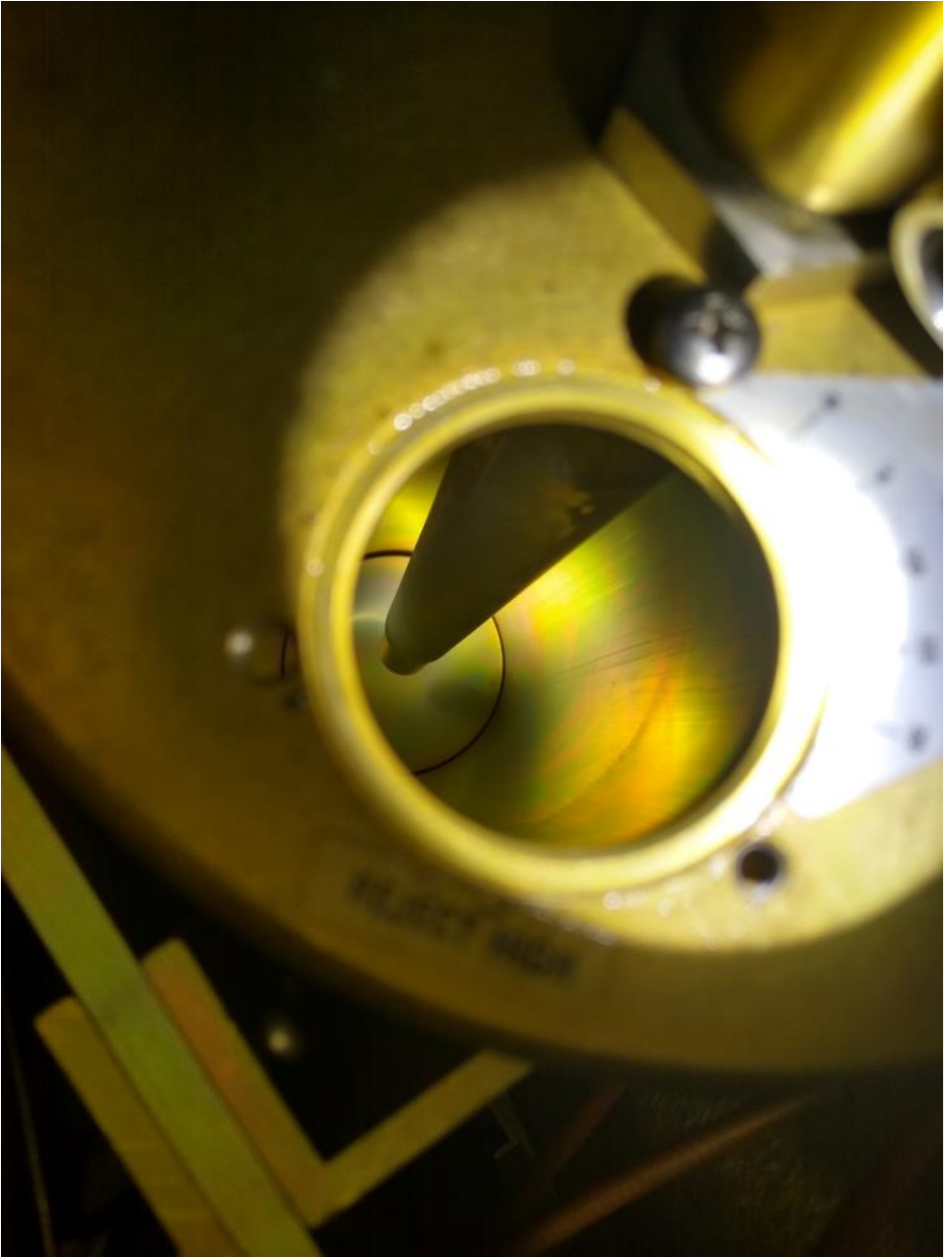


Photo G (Inside view of duplexer cavity)

Area Nets

Monday

7:00 PM 145.290 South-West Iowa ARES Glenwood, IA.

8:00 PM 144.250 NE Missouri SWOT.

9:00 PM 146.940 AARC Chat Net. Ak-Sar-Ben ARC Omaha, NE.

Tuesday

9:00 PM 145.310 Washington Co. ARES Washington Co, NE.

Wednesday

7:00 PM 146.670 Dodge Co. ARES Dodge Co, NE.

7:30 PM 7.122 CW Four State QRP Comfortable Net.

8:00 PM 3.564 CW Four State QRP Comfortable Net.

8:00 PM 145.310 Saunders Co. ARES Saunders Co, NE.

8:30 PM 7.122 CW Four State QRP Comfortable Net.

9:00 PM 3.580.5 PSK Four State QRP Comfortable Net.

9:00 PM 146.820 Pottawattamie County ARES Council Bluffs, IA.

Thursday

8:30 AM 7.122 CW Four State QRP 40M Morning Net.

7:30 PM 145.310- Lincoln/Omaha SATERN Net. Ashland, NE.

8:00 PM 28.350 SSB 10-Meter Net.

8:00 PM 144.250 2-Meter SSB Net.

8:00 PM 147.360 Heartland DX Association.

Friday

10:00 PM 224.760- Tone 146.2 Promote the Band Net

Saturday

12:00 PM 146.82 Swap Net Council Bluffs, IA.

8:30 PM 3.921.000 QCWA Chapter 20.

Sunday

8:00 AM 3.902.500 Swap Net.

8:30 AM 3.897.500 3900 Club.

8:30 PM 443.925+ (103.5 tone) IRLP Net.

2:00 PM 50.200 6 Meter Net

9:00 PM 146.940- Douglas Co. ARES net, KØUSA repeater.

Club Officers & Board Members

President	Sean Edwards	ADØQG	president@aksarbenarc.org
Vice President	Pat Connell	WØOJU	vicepresident@aksarbenarc.org
2018 Secretary	Brian Sohl	KEØGKB	secretary@aksarbenarc.org
2018 Treasurer	Dave Rice	NØJSB	treasurer@aksarbenarc.org
2019-2021 Director	Dave Rice	NØJSB	board@aksarbenarc.org
2019-2021 Director	Dan Buchholz	NØPOT	board@aksarbenarc.org
2018-2019 Director	Brian Sohl	KEØGKB	board@aksarbenarc.org
2018-2019 Director	Ray Blackburn	NØREA	board@aksarbenarc.org
Immediate Past President	Kevin Hill	KAØVNY	board@aksarbenarc.org

Club Committees

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Vice Chairman	Steve Schmitz	NØUP	repeater@aksarbenarc.org
Control Operator	Mary Joseph	NØTRK	repeater@aksarbenarc.org
Club Call sign Trustee	Corby Krick	KØSKW	trustee@aksarbenarc.org
Member	Russ Hilton	ADØQH	repeater@aksarbenarc.org

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NE Section Manager	Matt Anderson	KAØBOJ	ka0boj@arrl.org

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AKSARBEN ARC Club Meeting – May 8, 2020 The meeting was called to order at 7:04 PM by roll call on the repeater and introductions on Zoom. There were 17 attendees. Officers and Board members present included: Sean, ADOQG; Dan, NOPOT; Dave, NOJSB; Brian, KEOGKB; Rea, NOREA

Secretary's Report - Brian, KEOGKB – There were no minutes from the April meeting because there were insufficient members present to have a quorum.

Treasurer's Report - Dave, NOJSB – – As of April 30 the club accounts had balances of: Main Checking \$4,457.38, Repeater Checking \$432.45 Savings \$6,992.16, CD Life Member one \$6,484.77, CD Life Member two \$6,736.18, and CD Repeater \$1,122.22 This leaves the balance of all the club accounts at \$26,215.16.

In the month of April there were deposits of \$156.00 from membership dues. There were no April Monthly expenses.

President's Report - Sean, ADOQG – Due to Corona Virus many clubs have canceled their flea markets, The board has had discussions about canceling our Flea-Esta in September, The board has decided to continue to monitor the current events and will make the decision in July when more information is available. This will leave sufficient time to get a refund on the hall deposit.

Vice President's Report — Pat, WOOJU No report ARES/Disaster Preparedness/ ARES Steve NOUP – No report Community Events - Pat KOCTU- No report

SATERN – Mary, NOTRK – Salvation Army is currently involved with feeding people across the U.S. and there is a “Stay Connected” net that happens every Monday evening on the .94 repeater at 7 PM. This net is open to everyone. This is a way for all Hams to stay connected and everyone is reminded to check in on neighbors and be of assistance to anyone less fortunate.

Education Committee – Rea NOREA- we are currently researching ways to do testing and training online.

Membership Committee - Mary, NOTRK Most of you should have received an email from Ham Club Online to whatever email I have on file. Please logon and make sure your phone number is correct. Once things settle down we will begin using that for mailing list so make sure your information is correct. If you did not receive the email contact me at NOTRK@cox.net or NOTRK@arrl.net

Publications/Web Services Ham Hum - Brian, WEOBEP – no report

Web Services - Mary, NOTRK/Adam, KD0MMG – The website does need to be updated a little bit. If you have content that you think would be interesting let me know. We all have different interest and go down different paths. Also, we have had request that the Vice President share the program information on the website. Some members have to drive in and if it is an interesting topic, they will make an extra effort to come to the meeting.

Repeater – John- WB0CMC The members had a brief discussion about the repeater hanging for up to thirty seconds. It appears that if you turn of tone the issue seems to go away, Current thinking is that the Ashland repeater that does require tone is causing the problem. If you have tone off the Ashland repeater will not respond, and you will only be using the main repeater on the KETV tower. John “I will be visiting the Crown Point and Ashland sites in the coming week and will also be assisting the SWI-ARC club in isolating an issue on the .82 repeater”

Field Day – Adam, KD0MMG – There was a brief discussion on a doing a virtual field day by operating from your backyard using emergency power. There was also a discussion about possible sites to operate from also.

Courtesy Committee – Bill Snyder KD0FJR – I sent out a condolence card to the family of Bill Batchelor W5UZQ

Old Business – No old business

New Business – Due to the pandemic the board is looking for locations for the next meeting, Red Cross is currently closed to the public and we have no information on when any location will be open to the public, If you know of any location please let the Board know. If you are uncomfortable coming to the meetings it was discussed that all future meeting be also broadcast on Zoom.

Announcements Mary – NOTRK is currently scanning in old newsletters and posting them on the Club’s website, please look check the club’s website and Facebook for more information.

Door Prizes – no prizes until in person meetings begin again

Also, support your local repeater. The club accepts donations for any area repeater and forwards the money to the appropriate owner.

The following Committee's all reported None or No Reports:

QSL and Technical Committee - Eddy, K0IL – No report

Trailer/Equipment Committee - Mary, N0TRK – No report

Public Awareness – Jim, KA0KCV - No report.

Transmitter Hunt - Dave, N0JSB – no report

Flea-Esta – Chris – No report

There being no more business before the club the **meeting was adjourned at 7:45 PM**

The following information was compiled from discussions on the June 1, 2020 SATERN Net conducted by Mary-N0TRK (146.940 MHz)

The purpose of the Net is to offer Hams the opportunity to have discussions during our time that we should Stay at Home and be safe from contracting or spreading the Coronavirus by encouraging conversations as needed.

Mary's topic of discussion: "What do you have in your Grab and Go Bag?" Most of us know what a "Go Bag" is but if you do not; a Go Bag is generally a Large Duffle type Bag whose contents are what you need for an Extended Period of time away from home and in some cases away from the conveniences of stores at the location you are deploying to. However, a "Grab and Go Bag" is generally a much smaller bag with items you may need if you head out to a secluded location for maybe just a few Hours; such as a Storm Spotter location, an annual Siren location to inspect and monitor the testing of your assigned siren.

So From a Ham Radio Operator perspective, what should you take with you if you are to be assigned to a remote location for up to lets say 4 hours that you are expected to remain in place at that location?

Here are some of the comments which were brought up by those who were participating on the Net:

- Most people took for granted that you will have a Radio. However, it would be beneficial to have your radios manual on hand.
- If you are using a Handheld Transceiver (handy talkie) Bring extra batteries of some way to access alternate power such as maybe a cigarette lighter plug. [Do they even call them that now days ???]
- Sun or Rain Gear, as well as a Hat, Sunscreen, or windbreaker, Glasses as needed (prescription / readers etc..)

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- Something to write with and to write on: Note book or Tablet, and more than one writing instruments (Pens; be sure they work)
- If you have some of those two way radios that do not require a License to transmit, they could be useful to provide to individuals that might need to venture away from you post.
- You might want to bring some water or bottles drinks and snakes if you are going to be out for an extended period of time. I'm not sure what some folks would do if Nature Calls.... You may have to abandon your post to take care of business, but may still want to pack some type of toilet paper and hand wash/sanitizer.

Mary Closed the Net after each of us provided only one input, however, I thought this was really an important topic so I'm going to add a few more items below:

If using an HT radio, think about bringing a spare antenna. Especially if your HT has a rubber duck antenna. ON the same note of antenna's: my vehicle has a small seven inch antenna on the roof which is fine for the local area and also parking garages. But when I want to be sure to be heard, I will bring along a four foot antenna which has far better range if I venture away from the repeater antenna.

All good things to think about. Again special Thanks to Mary-NOTRK for providing this opportunity to encourage us to keep in touch with each other during these times.

Brian-WEOBEP