# ARRL FIELD DAY 2020



AC1GM

## ARRL Field Day - Amateur Radio's Premier LARP



### **Field Day Description**

It is a time where many aspects of Amateur Radio come together to highlight our many roles. While some will treat it as a contest, other groups use the opportunity to practice their emergency response capabilities. It is an excellent opportunity to demonstrate Amateur Radio to the organizations that Amateur Radio might serve in an emergency, as well as the general public. For many clubs, ARRL Field Day is one of the highlights of their annual calendar.

## **Typical Field Day Goals**

- <sup>"</sup> Exercise EMCOMM capabilities.
- <sup>"</sup> Public relations for Amateur Radio.
- <sup>"</sup> On-Air Contesting.

## **Implied Scenario**

EMCOMM support of civil authorities from portable stations in an electrical utility denied environment (Natural Disaster, EMP strike, etc.)

How can the reclusive ham capitalize on Field Day? Develop Enhanced Exercise Parameters  $\rightarrow$  LARP 2.0!

## Enhanced Field Day Parameters - LARP 2.0



### **Exercise Scenario**

Societal collapse resulting from civil unrest and COVID-19 lockdown measures.

### **Exercise Goal**

Establish an effective, reliable, survivable, and self-sustaining man-packable EMCOMM capability in an infrastructure denied hostile environment.

### Field Day Objectives

- Assemble/construct a capable man-packable radio station.
- <sup>\*</sup> Assemble suitable supplies for field sustainment.
- <sup>"</sup> Locate a QTH with suitable radio propagation and affording visual concealment.
- "Hike into QTH, setup camp and establish station.
- <sup>"</sup> Exercise EMCOMM and field sustainment capabilities.
- <sup>"</sup> Participate in ARRL Field Day 2020.
- Exercise Night Vision capabilities.

### **Future Field Day Objectives**

- *Exercise aerial reconnaissance capabilities (Drone Overflight).*
- <sup>"</sup> Exercise QRP & Digital Mode capabilities.
- <sup>\*</sup> Exercise SIGINT capabilities (Copy METARs, FD/PD Dispatch)

## The Station – Transceiver Selection



### TOP LEVEL GOALS

Man-Packable Effective/Reliable (QRO vs QRP) Reasonable Cost (Expendable)

### Man-Packability

Shack radio is a Yaesu FT-450. Bulky and weighs almost 9lb. Only "man-packable" radios are Mobile/QRP (IC-705, KX2, Xiegu, FT-818, FT-891)

### **Effective/Reliable**

- While operating QRP is fun; more power = more reliable comms all else being equal.
- Realities of field expedient antennas necessitate efficiency compromises when attempting to operate on low frequencies with typically higher noise floors.
- <sup>"</sup> Radio set is useless if desired receiving station cannot copy your traffic.
- <sup>7</sup> Trade-off between power level and battery life/weight.

### **Reasonable Cost**

Field conditions can be brutal. How badly will I cry if I destroy radio?

### The Selection

- Only reasonably man-packable radio available at 100W output was the Yaesu FT-891.
- Compact "mobile" size package, just under 5lb and cost under \$600.
- Fairly robust features, including a band scope. Also power hungry.

## The Station – Transceiver Continued



ENG 121072 111

### Automatic Antenna Tuner

- FT-891 lacks a built in antenna tuner.
- Added for frequency agility, utilizing non-resonant antenna designs, and adjusting for unsavory field conditions. (You put the antenna where?!)

### **Reliability Upgrades**

- Life in a rucksack isn't easy. Made sewn padded pouches from old mil surplus duffel bags and other items (COVID Shortages).
- Knobs are delicate. Added aluminum side rails to transceiver to shield operating knobs from bad stuff.
- Radio's can't breathe underwater. Procured rugged dry bags to protect radios from rain and limited submersion until deployed within a suitable shelter (tent).



Generator Power: Not an option – Too Heavy – Too Noisy Solar Panels & Batteries: Peanut Butter and Jelly Solar is the source - batteries are the storage. Need batteries to supply the peaks and provide energy when no sun. Need solar to charge the batteries when they are dead. How much solar? How many batteries? But first... Which Chemistry?! ~ Goldilocks & The 3 Bears





Radio Specification Data:

Input Power 13.8V +/- 15% (11.7 – 15.9V) @ 2A RX / 23TX ?!?!

### **Actual Measured Consumption:**

1A RX Signal Present – 15A TX 100W Carrier – 10A Peaks 100W SSB

### **Selection Criteria:**

Match voltage range Min. Battery Size to handle peak current

Max Battery Size (Ah) willing to Carry

Better to carry 2 smaller batteries than 1 larger (Scalability, remote charging)

Battery Life (Charging Cycles) – Irrelevant (It's just \$\$\$)

## Lead Acid Battery State of Charge

After 3 hour rest

State of Charge	12 Volt battery	Volts per Cell
100%	12.7	2.12
90%	12.5	2.08
80%	12.42	2.07
70%	12.32	2.05
60%	12.2	2.03
50%	12.06	2.01
40%	11.9	1.98
30%	11.75	1.96
20%	11.58	1.93
10%	11.31	1.89
0	10.5	1.75

Lead-Acid Batteries 100Ah Lead Acid costs ~ \$100 "15Ah" Lead Acid costs ~ \$35 Weighs ~ 65lb (0.65Lb/Ah) Peak Voltage ~ 12.7V Cut Off V ~ 11.6V (11.7V to Radio) Totally Dead @ 10.5V Ah Rating – Full to Totally Dead? Usable A/H only 75% of rating?

### NOPE!

~ 0.87 Lb/Ah = 13Lb for 15Ah ~ \$3/Ah = \$45 for 15Ah



#### **Radio Specification Data:** Input Power 13.8V +/- 15% (11.7 – 15.9V) @ 2A RX / 23TX ?!?! **Actual Measured Consumption:** 1A RX Signal Present – 15A TX 100W Carrier – 10A Peaks 100W SSB General: I noticed the Max and Peak Continuous Discharge on the label may be different from the website and why? The printed label may be rated to 1C Max Continuous or 2C peak. However, for some models of batteries including the BLF-1212A, BLF-1212AB, BLF-1212AS, BLF-1215A, BLF-1215AS, and BLF-1220A, 30 Amp and 40 Amp PCM/BMS boards have been installed. The de-rating on the label to 1C is mentioned to ensure the battery can deliver more than 2,000 to 3,000 cycles. However, rest assured these batteries can deliver the 23 Amps for your ham radio equipment which has a duty cycle of 20% Bioenno transmit and 80% receive. If you operate continuous at the 2C discharge (with no duty cycle), the cycle life is a bit less to about 1,800 to 2,000 cycles instead of 2,000 to Good Cust. Svc. 3,000 cycles.



15Ah LiFePO4 costs ~ \$150 (\$10/Ah) Weighs ~ 4.5lb (0.3Lb/Ah) Peak Current ~ 30A (See Above) Peak Voltage ~ 14.6V (4 @ 3.65V) Cut Off Voltage ~ 10V (4 @ 2.5V) (Note Radio Wants 11.7V ~ 3V/Cell) Ah Rating – (See Chart) Usable A/H = 100% of rating

LiFePO4

Radio Specification Data: Input Power 13.8V +/- 15% (11.7 – 15.9V) @ 2A RX / 23TX ?!?! Actual Measured Consumption: 1A RX Signal Present – 15A TX 100W Carrier – 10A Peaks 100W SSB

Li-Ion Chemistry Presents a Poor Voltage Match Without upgrading chargers and/or trying to Buck/Boost V's Max charge voltage of current gear = 15V = 3.75V per cell This presents issues at BMS with cell balancing...









### **Battery Selection**

- COVID: Only in-stock was 15Ah (30A peak) or 30Ah.
- Prefer multiple smaller batteries VS 1 large battery (Scale-able).
- Ordered a pair of 15Ah batteries.

### **Solar Selection**

- Selected pair of 60W panels.
- <sup>"</sup> Scale-able solution (parallel panels for more power).
- Each panel weighs about 3lb and fits inside a ruck sack.
- No such thing as free lunch: 120W VS 2 X 60W Same Weight

### **Ruggedizing**

- Shrink wrapped case is not particularly rugged. Tried to make hard case, too much added weight and bulk.
- <sup>7</sup> Added 2<sup>nd</sup> and 3<sup>rd</sup> layer of shrink wrap to improve durability.
- Purchased dry bags to store batteries. Batteries can operate from within dry bag.
- Solar panels were sufficiently durable as is.







### **Battery/Solar Management (Buddipole Power Mini+USB)**

- Solar charge controller.
- Battery Management.
- Power Distribution (Pair of APPs).
- 5V USB Power Port



## The Station – Antenna Selection

### **Antenna Selection Criteria**

- High Efficiency (avoid lossy ground) / Light Weight / Multi-band
- Near Vertical Incidence sky-wave (NVIS) on 80m (night) and 40m (day) for regional COMMS.
  Provide moderate skip sky-wave coverage of CONUS on 40m and 20m.
- Potential for Usable capability for NVIS on 160m running against ground?
- Minimize ground/surface wave signature to thwart RDF

### ALL INDICATIONS POINT TO A LOW DIPOLE (~35ft High)













## The Station – Antenna Selection – 160M?

Can I use this antenna on 160M running against ground in a pinch? Connect 45' and 90' wire to make 135' wire and run against ground Inserted resistance load in EZNEC adjacent ground point to simulate Lossy ground (hasty radial field 25 Ohm?) Ground losses make SWR appear more favorable... Antenna is down by 9dB so 100W in turns into QRP out. Not great, but better than nothing... Carrying 2x more wire not worth it.

EZNEC+ doesn't like to model Low horizontal wires AND Connection to ground... (Cant Justify \$1,000 for NEC4... Yet) TAKE ALL WITH GRAIN OF SALT!

INF

10

SWR

1.5

1.1



EZNEC+



## The Station – Antenna Construction



# The Station – Stakes & Guys



The Station – Transmission Line





## Field Sustainment - Shelter

Small, packable tent. Full Black-Out, 4 season. Generous Vestibules for gear storage. Most importantly, low visual profile & IR signature.

## **TCOP** Tent, Combat One-Person



#### **TCOP FOOTPRINT**



#### SPECIFICATIONS

- · Freestanding, 3-pole, dome tent with bathtub floor
- 28 square foot main tent body
- 7 lbs. (tent, fly and frame)
- Height: 32.5" (+/- 1")
- 2 vestibules for 17 square feet of additional gear storage
- Tent body is flame retardant, 70D, 98P polyurethane coated ripstop nylon - 2 large drop-down doors with mesh windows
- Rain Fly: Woodland Camo Fly is reversible, flame retardant, full coverage blackout material with taped seams - 2 vestibules - fly is reversible to Desert Tan (Digital Camo Fly not reversible)
- All netting is 40D nylon "no-see-um" for protection from dust and small insects
- Easy shock corded, cold weather, black anodized aluminum frame (.344" diameter)
- Repair Kit includes one pc. frame repair sleeve, needle, thread, thimble, one set of extra guy lines, 12' cold weather shock cord with 'shok locs', 12"x12" swatches of all fabric and replacement toggles, buckles, tapes and web included with each tent



INSTEAD I BROUGHT A LEAKY 4-MAN DOME BECAUSE IT WOULD BE "MORE COMFORTABLE"



## Field Sustainment – Water & Hot Chow

Freeze dried food – Save on weight (and delicious!) Small backpacking stove + Makeshift French Press Water Sourced on Site to Save Weight QTH on Private Land – Bonus Coyote Hunt



## Field Sustainment – Sleeping Gear

MilSurp – Modular Sleep System – 2 Bags 1 Bivy Use in any combination – Comfy even when wet (Ask me how I know)

Too much to pack for Summer, stuff the LW green bag In a MAC Sack dry bag, very low overhead.

Therma-rest – Big 3" fatty because I'm a huge baby.



## Field Sustainment – Miscellaneous









## The QTH

- Friend's Property in Foster RI
- Access to Drinkable (?) H2O
- Concealment Edge of Marsh
- Area Wet Marsh Flooded
- (Notionally good for RF)
- <sup>7</sup> Isolated Area Less RF Noise
- Semi-Maintained Path Access
- Private Land

2020 Google

820 ft

## **Field Day Summary**



Hiked 0.4 miles with 105lb Pack. Tossed line about 35' up into a White Oak. Trudged thru marsh muck to set guys. Cut up by briars attacked by flies. Got rained on (even in the tent). Mosquitoes and Ticks. Made 50 QSOs in 5 hours of "Casual" operating on 80m, 40m, and 20m. Seemed to bust thru piles-ups with ease? Used 10Ah of battery in the 5 hours. Not much Solar (Overcast + Trees) Walked aimlessly thru the woods in the dark under night vision. Ate lots of delicious Mountain House. Drank lots of weak coffee (Wrong Grind?) Kept watch for Coyotes. Had a great time!