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The Russian Woodpecker a Blast From the Past

- Today we will discus the largest man Made Radio Frequency Interfering Signal known to the World as the Russian Woodpecker
- We will review its sheer size and analyze the arrays and the elements based on scaled images and predict antenna patterns using FEKO
- We will try to dig up the history and use of these antenna arrays and dig through many of the hidden secrets to that irritating noise that cursed the airwaves from July 4th 1976 to 1989
- This Antenna Array is known as Duga 3 and we will see what if any is the connection to the **Chernobyl Nuclear power plant** next door

Why is it Called the Woodpecker?



The purpose of the Duga 3 Array was to use Over the Horizon Radar to Detect American Nuclear Missiles at the initiation of their Flight Paths Thus giving them 25 Minutes of Early Warning to Prepare a Response

SPOILER ALERT SPOILER ALERT SPOILER ALERT

Conclusion – The Russians had working 16 MHz, 8 Mhz, and were working on 4 MHz Over the Horizon Radars when it turns out the Northern Lights Obscured the 4 MHz antenna Pattern – Money Spent





Duga 3 Antenna Stats

- The Metal Construction of the Radar is composed of two parts
 - A Low Frequency Antenna Height 150 Meters and Length 500 Meters
 - A High Frequency Antenna Height 100 Meter and Length 250 Meter
 - Weight was 14,000 tons
- Construction Began in 1972
- The Antenna Started Broadcasting July 4, 1976
- It made a tapping sound on the Ham Radio Bands that sounded like a wood pecker
- It took 4 Years to Build
- And was on the air for 13 Years



DUGA 3 – The Russian Woodpecker

Unit of Measure = Football Fields



Note 1 Football Field is **300 ft x 160 ft** ... **15 football fields** could fit on the face of the large array!



Car from 492 Ft high The Giza Pyramid is 481 ft High and 756 ft Wide at the Base Note the size comparison to the Duga 3 Large Antenna Array



View From The Back Side, it is Looking Towards the US Let's Check it out

A CH



Aerial View of the Duga Array imported into AutoCad – Angle measured from the latitude lines

USING GREAT CIRCLE MAPPER The Flight Paths to Miami is 302 Deg and to San Francisco its 339 Deg ... Duga 3 Points right down the alley way at 325.2 Deg



UKKK is Kiev, Ukraine,	, DME is Moscow
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From	То	Initial Heading		Magnetic Heading		Distance
4 segme	nt path:		1	1		
UKKK	MIA	302°	(NW)	294°	(NW)	5,705 m
MIA	<u>SFO</u>	299°	(NW)	306°	(NW)	2,585 m
<u>SFO</u>	UKKK	017°	(N)	004°	(N)	6,150 m
UKKK	DME	039°	(NE)	031°	(NE)	<u>465 m</u>
						14,905 m

Di	sta	nc	es

From	То	Ini Hea	Initial Magnetic Heading Heading		Distance	
4 segme	nt path:	825			~	
UKKK	<u>SFO</u>	339°	(N)	331°	(NW)	6,150 mi
<u>SFO</u>	MIA	096°	(E)	083°	(E)	2,585 mi
MIA	UKKK	037°	(NE)	044°	(NE)	5,705 mi
UKKK	DME	039°	(NE)	031°	(NE)	<u>465 mi</u>
					10781 SF	14,905 mi

Minutemen Bases in the US - 1988

STRATEGIC AIR COMMAND ICBM FORCE - 1988



I added the slide at the last minute!

+ U.S. GOVERNMENT PRINTING OFFICE: 1990-754-000/1151



15 yard penalty – Interference with the Ham Bands







http://www.youtube.com/watch?v=aOMVdOc9UbE&list=PLD3FB69E821379573

http://www.youtube.com/watch?v=9AlQ5sbSJwc

Steve's Superlatives for the Duga Array

- **Biggest**. Nope. That title belonged to **Arecibo** in Puerto Rico, which has a 1007-foot aperture. Recently surpassed by China's FAST reflector at 1,640 feet.
- Tallest. Nope at 500 ft it's not as tall as, say, WLW's 831 ft tower built in 1933 by Blaw-Knox. An airplane hit the tower in 1935. The tower was undamaged. I won't count the 2,120-foot Warsaw longwave radio tower, which transmitted 2 MW, because it fell down (and not because of an airplane strike).
- Most powerful. Nope. Duga radiated 10 MW EIRP, but HAARP array in Alaska can transmit 3.6 MW total radiated power.
- Most expensive. Possibly. 7 B Rubles would be 44 B Rubbles today if matched to the Dollar's inflation rate (and the actual number is greater because the Ruble had hyperinflation). Or **\$600 Million in todays money**.
- Heaviest. Definitely. At an estimated 13,000 to 23,000 tons, the Duga array is heavy, 3.5 times the weight of the Eifel tower.
- **Prettiest**. Definitely. Rising out of the forest, sticking above the clouds, or viewed from any angle, photos of Duga are **magically majestic**.





You want your receiver in a quiet town. Lyubech is rural with a population of 2086. That is probably where the receiver was.

Quick facts

Liubech or Lyubech is a small ancient town connected with many important events since the times of Kievan Rus'. It is located in Ripky Raion, in Chernihiv Oblast of northern Ukraine. Liubech is 250 kilometers north of the capital of Ukraine, Kiev, and located near the Belarusian border. Population: 2,086 <u>Wikipedia</u>

The Polesie State Radioecological Reserve is a radioecological nature reserve in the Polesie region of Belarus, which was created to enclose the territory of Belarus most affected by radioactive fallout from the Chernobyl disaster. The reserve adjoins the Chernobyl Exclusion Zone in Ukraine.

What if the Duga 3 was Really Transmitting?

- Possible Miscarriages for Pregnant Women? Maybe
- People in the Buildings would be subject to high EMI? Maybe
- The Duga 3 is transmitting 10 MW Eirp needs a lot of energy and that is probably why it is so close to the Chernobyl Power Plant
- The Receive site needs an RF quiet environment to hear the radar return signal better
- A high power transmitter can be near a populated area as it will overpower any RFI in town!

https://www.wia.org.au/newsevents/news/2008/20081221-1/index.php





- Transmitter Duga 3 a few km Southwest of Chernobyl
- Receiver 50 km Northeast of Chernobyl just West of Chernihiv
- Code Name 5H32
- Repetition 10 Hz and sometimes 16 and 20 Hz
- Bandwidth 40 kHz

https://www.wia.org.au/newsevents/news/2008/20081221-1/index.php

Identification Of The Woodpecker

Triangulation quickly revealed the signals to come from Ukraine. Confusion due to small differences in the reports being made from various military sources led to the site being alternatively located near Kiev, Minsk, Chernobyl, Gomel or Chernihiv. All of these reports were describing the same deployment, with the transmitter only a few kilometers southwest of Chernobyl (south of Minsk, northwest of Kiev) and the receiver about 50 km northwest of Chernobyl (just west of Chernihiv, south of Gomel). Unknown to most observers, NATO was well aware of the new radar installation, which they referred to as Steel Yard.











Tell me THE FREQUENCIES!

18 Meters

- 16450 kHz
- 16490 kHz
- 16570 kHz

• 16390 kHz

• 8070 kHz

36 Meters

- 8230 kHz
- 8310 kHz
- 8260 kHz

The frequencies were hopped in the order shown above

Let's try to remove some of the fog on the Cage Dipole and the Wire Screen





FEED BOX

This is one hefty feed box if the antenna was receiving small signals



Twin Leads Connect to the Cage Dipoles and there is a Insulated Support as well



Cage Dipoles and Wire Screen Back Plane



Supporting the Cage Dipoles





Cage Dipole Feed Point



Diagrams from Sergei Nadenenko's book "Antennas," in the original Russian



How to Build Your Own Cage Dipole for Better Bandwidth at HF



One Side of the Cage Dipole Full Dipole Length = 25 m



This photo has good detail and so I imported it to AutoCad and digitized the outline to create a model in FEKO

Cage Dipole vs Simple Dipole Reflection Coefficient



Reflection coefficient Magnitude

25 Meter Cage Dipole - Digitized from Photo



VSWR - New Cage 275 Ohms

Ground Screen to Dipole Distance for Highest Gain = .18 Wavelengths at 8.26 MHz thats 21.43 ft

Cage Dipoles and Wire Screen Back Plane



The Length of the Cage Dipole is Scaled from the full array model i.e. 25 m



We can increase the Gain of a Dipole by Putting it .18 Wavelengths in front of a reflector



Elevation Pattern 25 m Cage Dipole at 8 MHz

Total Gain (Frequency = 8 MHz; Phi = 90 deg)



Fotal Realised gain (Theta = 90 deg; Phi = 90 deg

In sl an lan eaus ma(n)lud e 2 Y 2 E -Field (d E V (m) 35 50 D 35 50 D 35 50 D 37 20 D 37 20 D 37 20 D 37 20 D 31 20 D 15 20 D 15 20 D

ELECTRIC FIELD SINGLE ELEMENT TOP VIEW

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In el an l an exu e magn llud e 2 Y 2 E -Pield (d E V (m) 35 0 D D 35 0 D D 37 0 D D

ELECTRIC FIELD SINGLE ELEMENT WITH REFLECTOR TOP VIEW









Scott Burnside said you twist the pair, if they are a quarter wavelength they will Be in phase...



b= 21.4 ft

- c= 20.8 ft
- a= 29.9 ft

.18 Wavelengths From **Steve Stearns** From **Keith Snyders** Autocad

Calculated

At 8.26 MHz Wavelength = 119.1 ft

a in Wavelengths = 29.9/119.1 = **.251** Wavelengths!





To Digitize a photo, get jpg Put into paint, Save as .bmp Import to Autocad as OLE object, Draw lines over objects, Export as Iges file, Import to Feko, Scale to known length (i.e. 500 meters), use Tools and read off dimensions

Dimensions (in Feet) from Photo – Scaled with top screen made to Equal 500 Meters

- Dipole length = 82.021 ft
- Spacing Adjacent columns = 54.058 ft
- Spacing for Elements on the same row = 106.9356 ft
- Height = 451.15 ft
- Vertical spacing = per column 41.6791 ft
- Vertical spacing = per alternating columns 20.8039 ft

Dimensions in Meters

- Dipole length = 25m
- Spacing Adjacent columns = 16.477 m
- Spacing for Elements on the same row = 32.594 m
- Height = 137.54 m (screen to top of gantry)
- Wire Screen set to 500 m at the top of the towers
- Vertical spacing = 12.7038 m per column
- Vertical spacing = 6.3519 m per alternating columns

The Large Array has 15 Antennas across and 20 Antennas High A total of 300 Dipoles Which means 300 feed segments and 300 feed excitations Which means a lot of hours to put this model together

> Screen Distance Behind Array Is 21.433 ft for 8.26 MHz

Top View showing the Sandy Soil in Front of the Array





Large Array Elevation Pattern

Antenna Gain Horizontal Pol



Phi Gain [dBi] (Frequency = 8.26 MHz; Phi = 0 deg) - Woodpecker_Redo_Low_Nearfield



Phi Gain [dBi] (Frequency = 8.26 MHz; Theta = 84 deg) - Woodpecker_Redo_Low_Nearfield





Now you can see all the Sidelobes that sprayed the world with tap tap tap

Peak Gain 29.4 dBi

Phi Gain [dBi] (Frequency = 8.26 MHz; Theta = 84 deg) - Woodpecker_Redo_Low_Nearfield

8.26 MHz







Uniform Illumination 8.26 MHz Antenna Pattern – Possible EMI if 10 Mega Watts



8.26 MHz







Field Strength with 10 MW Input Power



Nuclear Bunker and Tunnels

Drill Ground







The soviets had done some pretty extensive work on exposure and exposure limits. One reference (National Academy of Science) puts the Soviet Union occupational limit at 50 V/m or 17 dBv/m. A more modern work (International Commission on Non-Ionizing Radiation 2020) puts the 8 MHz limit at 170 V/m or 22 dBv/m. The predicted levels seem to fall in line with these levels, and if the buildings provided a modicum of shielding, the levels are not remarkable

Scott Burnside

Table 3. Reference levels for occupational exposure to timevarying electric and magnetic fields (unperturbed rms values).

