

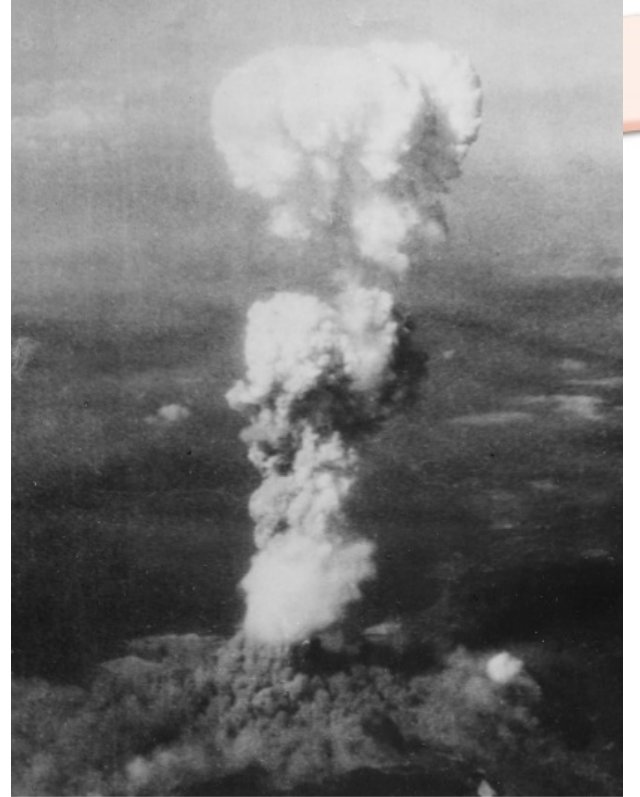


# Nuclear Attack and Emergency Communications

April 2022  
Gordon Gibby KX4Z NCS521

# Overview

- 1) Primary effects of nuclear attack
- 2) Secondary effects
- 3) Communications Issues
- 4) Volunteer Response

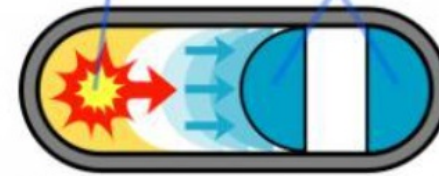


Immediate mushroom cloud over Hiroshima

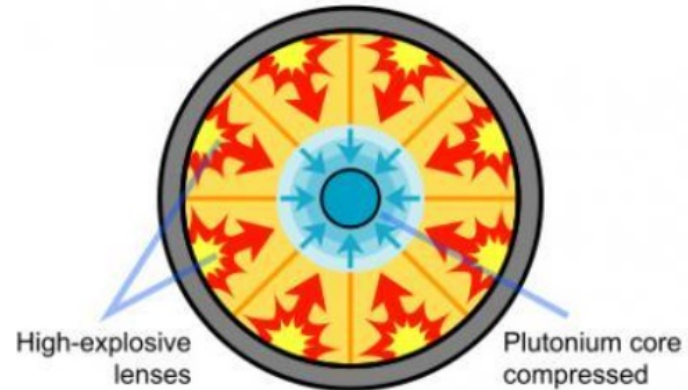
# Fission Technology

- Artillery gun U-235  
type: Little Boy
- Implosion Pu-239 type:  
Fat Man
- Reference:  
<https://www.atomicheritage.org/history/science-behind-atom-bomb>

Conventional chemical explosive      Sub-critical pieces of uranium-235 combined



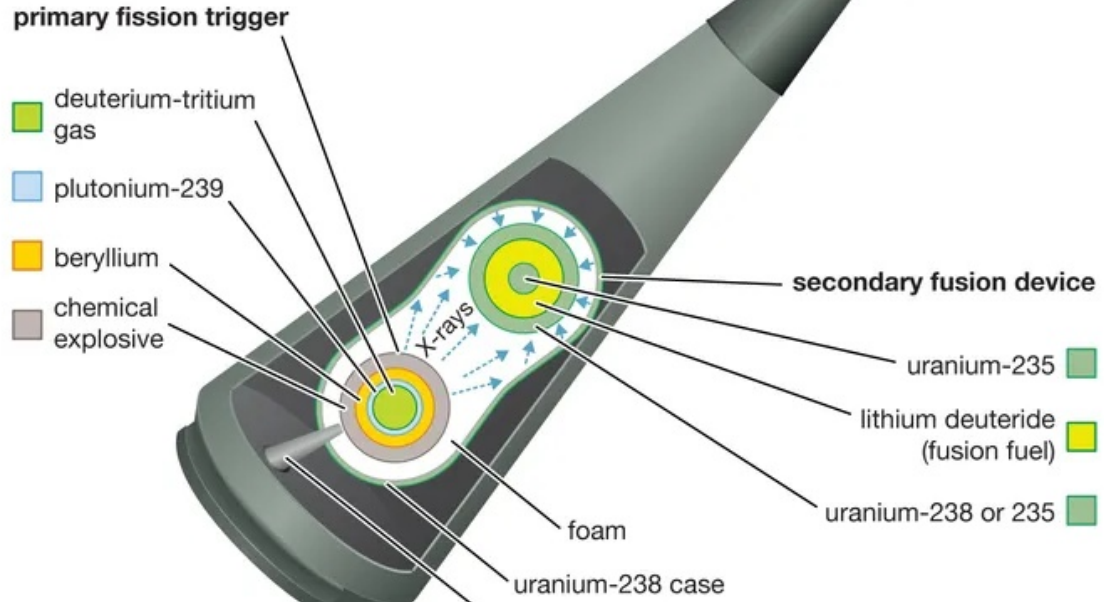
**Gun-type assembly method**



**Implosion assembly method**

# Thermonuclear bomb (Fusion)

- Fission-Fusion
- Multiple different types.
- Radioactive fallout primarily from uranium fission
- Ref:  
<https://www.britannica.com/technology/thermonuclear-bomb>



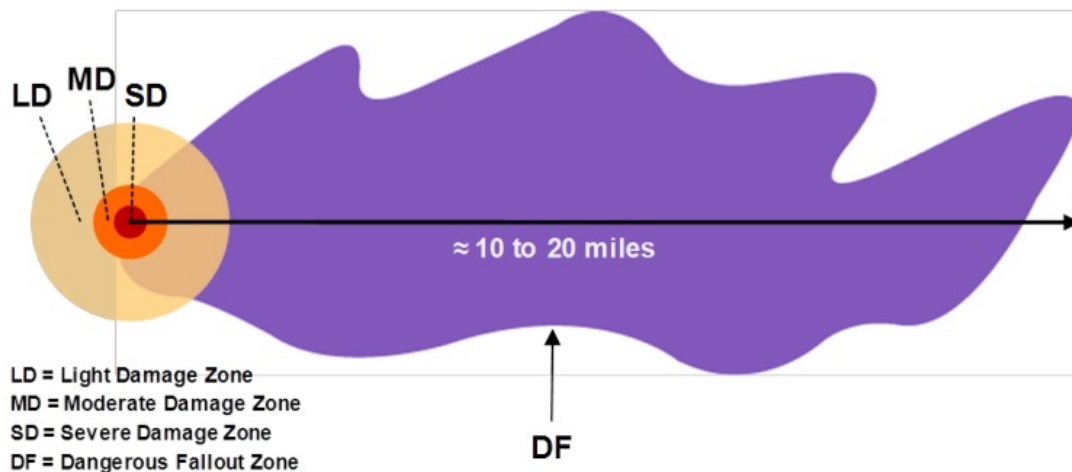
# Nuclear Attack: Primary Effects



- Ground Burst: sucks up more matter = more fallout
- Air burst (typ < 1 mile) = wider killing range but less fallout
- High Altitude (HEMP): EMP widespread impact to destroy electronic/electrical infrastructure.
- Destructive Radius = approx 5 psi over pressure zone (air burst radius) (destroys buildings, not to mention people)
  - 100 kiloton = 2 miles radius
  - 1 Megaton = 4.4 miles radius
  - 10 Megaton = 9.4 miles radius
- Neutron Bomb (enhanced radiation) – tactical often low yield, but **extremely lethal neutron radiation** quickly lethal to soldiers in near area, even behind most armor. USA believed to no longer utilize

# Tiny 10kT Attack

- Heavy Damage 0-1/2 mi - destroyed
- Medium Damage 1/2-1 mi (like a tornado)
- Light Damage 1-3 mi (windows broken)
- MegaTon bomb – far larger.
- Ref:  
[https://www.dhs.gov/sites/default/files/publications/Quick Reference Guide Final.pdf](https://www.dhs.gov/sites/default/files/publications/Quick%20Reference%20Guide%20Final.pdf)

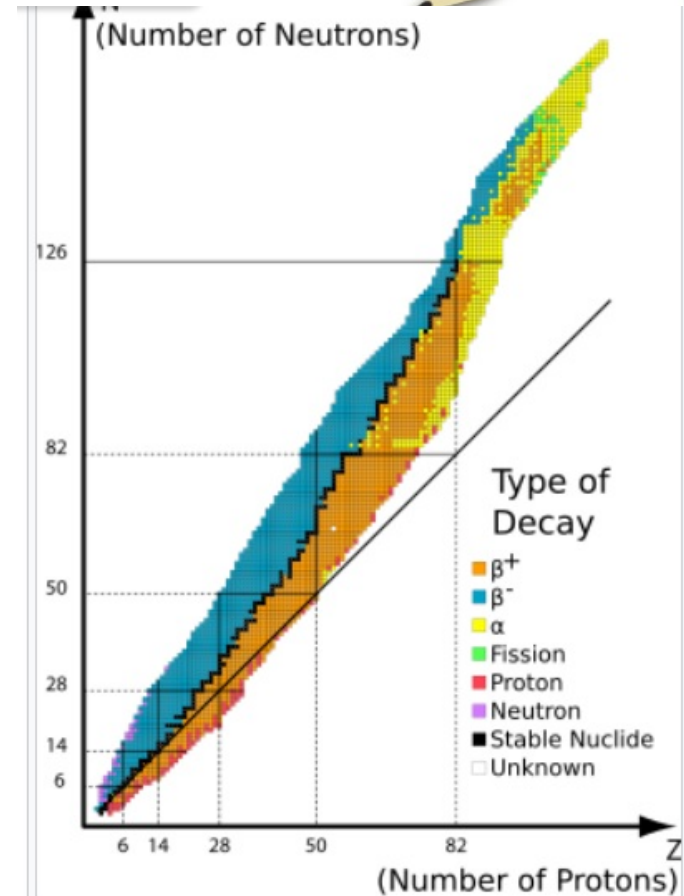


# Immediate Effects

- Nuclear Flash (much brighter than sun; blinding) [Length of flash related to yield]
- Concurrent THERMAL (Heat) rays – 30-50% of energy (burn you to death) (inverse square law?)
- Blast Damage 40-50% of energy. Extreme wind/pressure (>>tornado)
- Concurrent Prompt Radiation – 5% of energy (> if neutron bomb) kills by acute exposure to radiation (inverse square law?)
- Residual Radiation 5-10% (radioactive fission particles, irradiated particles: neutrons can make other items radioactive.)

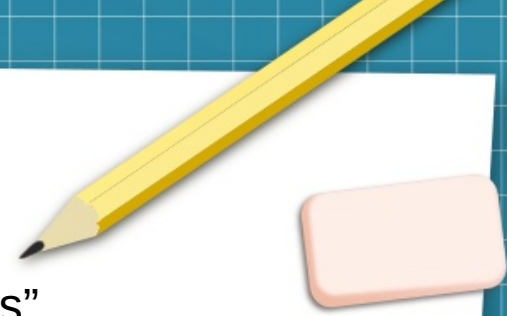
# Making ordinary things radioactive

- Adding neutrons from irradiation can make ordinary items radioactive
- (Fission products from uranium are also radioactive)
- (fusion products not so)





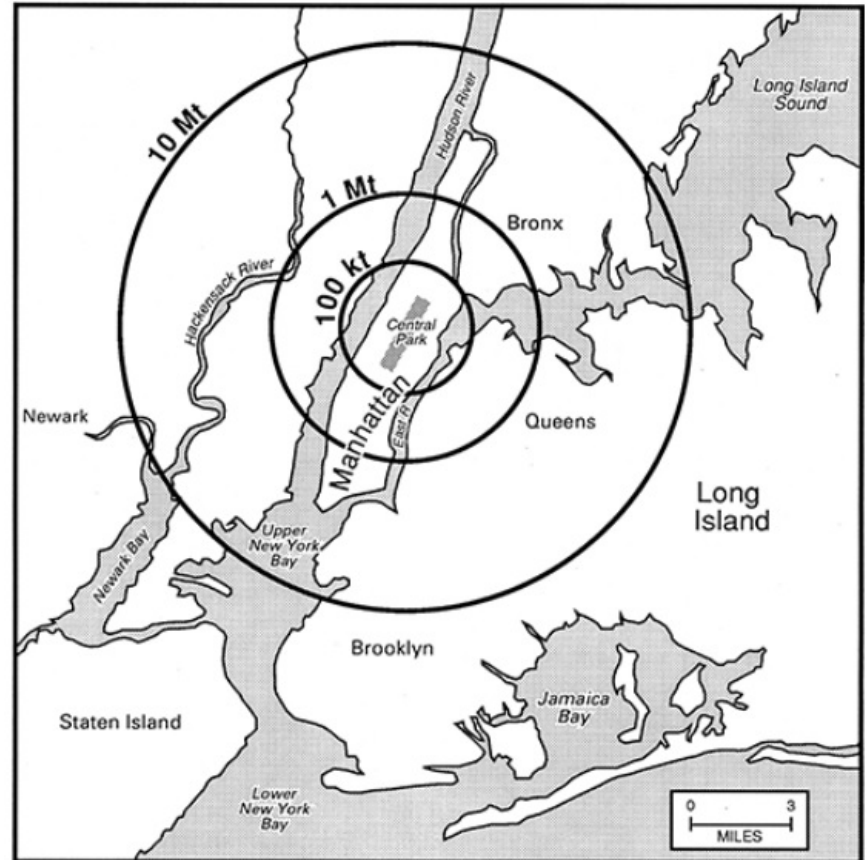
# Immediate Impact



- Immediate fireball = air heated (to millions of degrees) by “soft xrays”
- Hydrodynamic pressure front expands at supersonic speeds, briefly obscures the fireball
- As shock wall expands further, bright flash (many times brighter than sun @ 50 miles) visible again. “Double Flash” = atomic bomb (because of shock wall)
- 8 psi = complete destructions of wood or masonry structures
- 5 psi = damage to structures
- Blast wind = approaches speed of sound (destructive of humans)
- Flash burn – burns to skin or retina (DONT LOOK)
- [https://en.wikipedia.org/wiki/Effects\\_of\\_nuclear\\_explosions](https://en.wikipedia.org/wiki/Effects_of_nuclear_explosions)

# Immediate Destruction Area

- Greatly depends on yield
- <https://thereader.mitpress.mit.edu/devastating-effects-of-nuclear-weapons-war/>



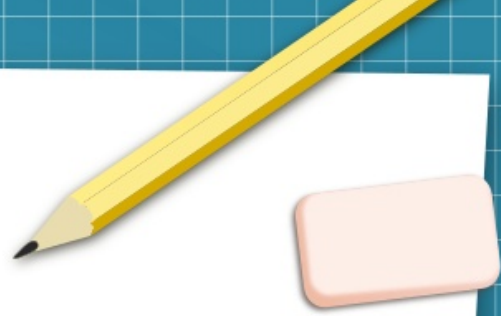
# Immediate Survival



- DROP away / shelter – avoid blindness and kinetic / thermal destruction of your skin (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> burns)
- Must avoid the THERMAL WAVE effects
- Must avoid immediate blindness
- Assuming you are outside the area of immediate destruction, must avoid the quickly arriving BLAST WAVE effects
- 
- AFTER the blast wave, move toward radiation shelter.

# Next Risk: Delayed Fallout

- Upper Level Winds carry radioactive debris
- Typical wind speeds 30-50 mph
- **Rain may be deadly:** deposit huge amount of radioactive material
- Dust will begin falling as the upper level winds get to your area
- Wind direction is crucial to where radiation goes!!!
- Dust is highly radioactive.
- Fission products
- Neutron-activated products



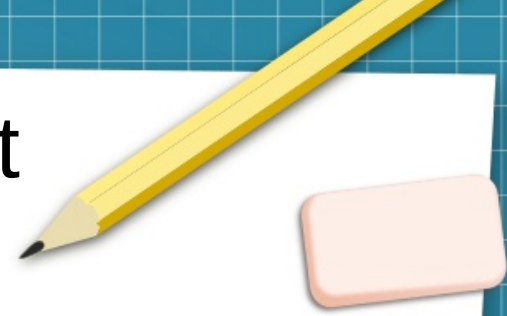
# Radioactive particles / etc



- **Alpha particle** = helium nucleus, can't get through paper, but if you EAT it, will kill you (poisoning of Litvenko by polonium in his hot tea). Horrible death
- **Beta particle** - high energy electron, makes it through a bit of paper. Thus tends to BURN SKIN (because it can't get much deeper)
- **Gamma Ray** – high energy photon, travels through concrete, steel etc. You want a LOT OF MASS between you and gamma emitters. Absorbed by electrons. High density metals (lead) have lots of electrons. ***This is the one you have to work hard to survive in your "safe room" for days after a nuclear fallout event.***

# Amount of radioactive fallout

- Amount depends of exact bomb and deployment
- Fissile material typically unstable due to excess neutrons.
- Fission products therefore often excess neutrons – unstable
- Neutron release makes OTHER materials unstable – radioactive.
- Wide range of half-lives of products.
- 



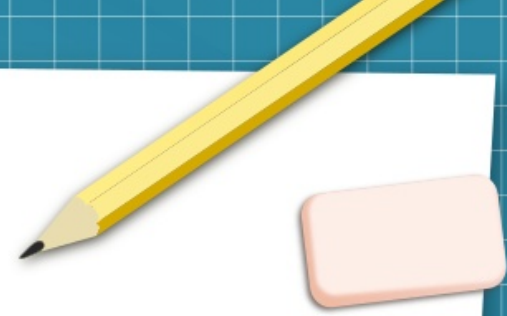
# “Protection Factor”

- Quantization of amount by which incident gamma is reduced before hitting you.
- Air = very little
- Lead = quite a bit
- You want HUNDREDS of POUNDS of mass or many many feet of air between you and radioactive fallout.
- Underground = best
- Center of LARGE house = maybe as good as you can get
- Pile FOOD, WATER, Heavy materials all round your safe room.



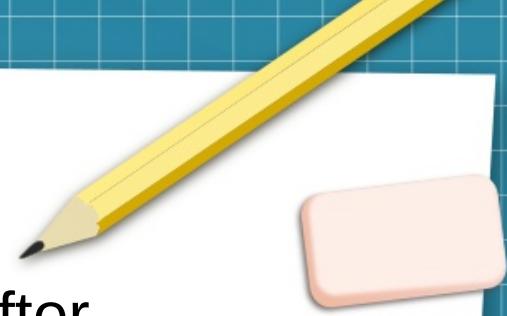
# Surviving the Initial Fallout

- Critical Period depends on fallout & strength.
- Measuring incident radiation will guide you
- Likely 2-5 days before safe to do ANYTHING
- Plan on:
  - Food, water, toileting
  - Security against ANYONE coming INSIDE from OUTSIDE
  - Very LIMITED outside trips after the initial days...
  - Radioactivity may be concentrated by plants or animals.
  - Concern for food supply.





# 7-10 Rule



- 7-10 Rule: For every sevenfold increase in time after detonation, there is a tenfold decrease in the radiation rate.
- So, after seven hours the radiation rate is only 10% of the original and after
- 49 hours ( $7 \times 7 = 49$ ) it is 1%
- Fallout: Fine, sand-sized grains.
- Ref:  
[https://www.dhs.gov/sites/default/files/publications/Quick Reference Guide Final.pdf](https://www.dhs.gov/sites/default/files/publications/Quick%20Reference%20Guide%20Final.pdf)

# Acute Radiation Sickness

## Acute Radiation Syndrome (Radiation Sickness) \*

Feature or Illness	Effects of Whole Body Absorbed Dose from external radiation or internal absorption, by dose range in rad/Gy				
	0-100 (0-1)	100-200 (1-2)	200-600 (2-6)	600-800 (6-8)	>800 (>8)
Nausea/Vomiting	None <sup>a</sup> (see note)	5-50%	50-100%	75-100%	90-100%
Time of Onset after Exposure		3-6 hr	2-4 hr	1-2 hr	<1 hr to minutes
Duration		<24 hr	<24 hr	<48 hr	<48 hr
Lymphocyte Count (blood)	Unaffected	Minimally Decreased	<1,000 at 24 hr	<500 at 24 hr	Decreases within hours
Central Nervous System Function (brain & nerves)	No Impairment	No Impairment	Cognitive impairment for 6-20 hr	Cognitive impairment for > 20 hr	Rapid incapacitation
Death	None	Minimal	Low with aggressive therapy <5 to 50% <sup>b</sup>	High	Very High

\*Prompt health effects from whole-body absorbed doses received within a few hours.

For practical purposes after nuclear, 1 rad = 1 rem

<https://www.dhs.gov/sites/default/files/publications/Quick Reference Guide Final.pdf>

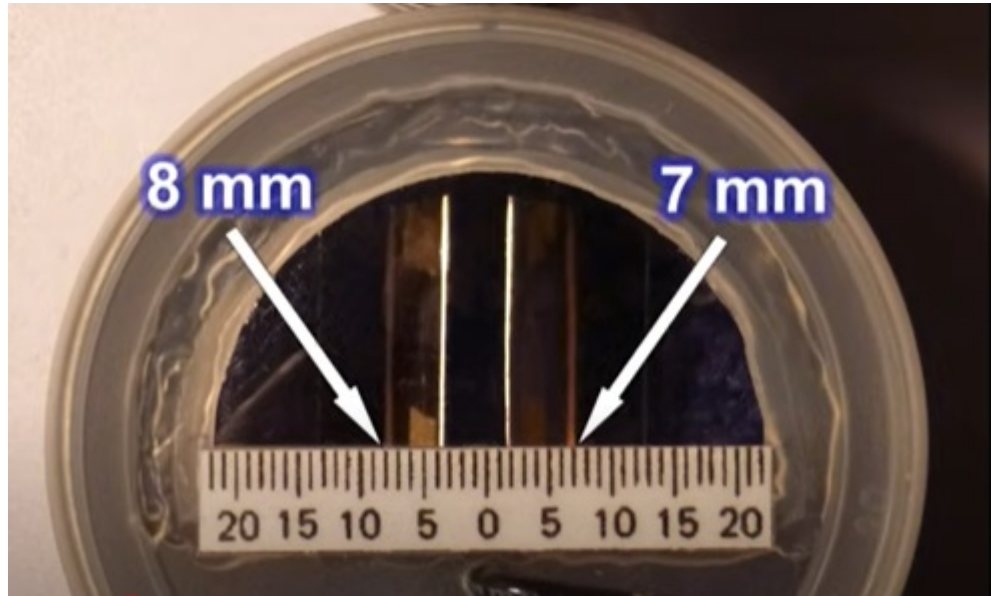
# Kerny Fallout Meter – Oak Ridge, 1979

- You would like to stay under 200 rem (200 rad)
- Assuming 48 hours for acute dose, this means stay under 4 rem/hr



# Building (or buying) a KFM

- 3 Videos – build yourself
- Scott Gruebel
- <https://www.youtube.com/watch?v=9eLN0P-SCcU>
- Kits (\$) and even completed versions (\$\$) available from [ki4u.com](http://www.ki4u.com):  
<http://www.ki4u.com/kfm.htm>



# KFM

- Leaves of aluminum foil separated due to charge imposed; rate of leaves falling together tells amount of radiation.
- <https://info.ornl.gov/sites/publications/Files/Pub57069.pdf>
- Detailed home construction details.
- <4 Rem/hr = Leaves collapse less than 4 mm / minute

**TABLE USED TO FIND DOSE RATES (R/HR)  
FROM KFM READINGS**

*\*DIFFERENCE BETWEEN THE READING BEFORE EXPOSURE  
AND THE READING AFTER EXPOSURE (8-PLY STANDARD-  
FOIL LEAVES)*

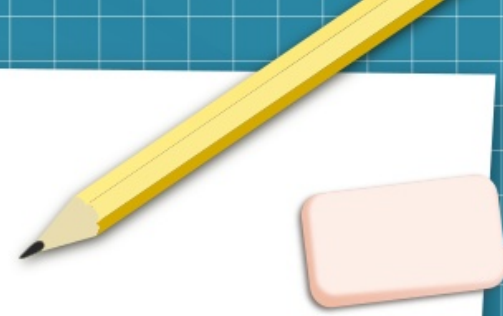
READ- INGS	DIFF.* IN TIME INTERVAL OF AN EXPOSURE				
	15 SEC. R/HR	1 MIN. R/HR	4 MIN. R/HR	16 MIN. R/HR	1 HR. R/HR
2 mm	6.2	1.6	0.4	0.1	0.03
4 mm	12.	3.1	0.8	0.2	0.06
6 mm	19.	4.6	1.2	0.3	0.08
8 mm	25.	6.2	1.6	0.4	0.10
10 mm	31.	7.7	2.0	0.5	0.13
12 mm	37.	9.2	2.3	0.6	0.15
14 mm	43.	11.	2.7	0.7	0.18

# Protecting Your Thyroid



- Thyroid actively takes up element IODINE to make its iodinated products T3 & T4 that are important to life.
- It may absorb radioactive iodine produced by the atomic attack.
- To prevent this, persons under 50 are recommended to take potassium iodide or potassium iodate tablets ASAP a nuclear attack (taking half a day before would be even better).
- See: <https://www.fda.gov/media/72510/download>

# FDA Suggested Dosage

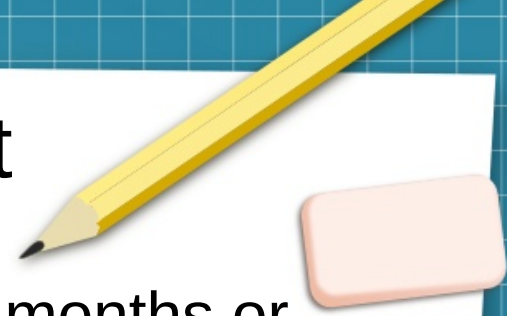


- Risk is much greater for younger children etc.
- Avoid overdosing also. Take only during risk period.
- Suggest daily for first 3 days then reconsider?
- Tablets are over the counter but may become scarce during widespread panic.
- Local authorities may have caches of medications.

<b>Threshold Thyroid Radioactive Exposures and Recommended Doses of KI for Different Risk Groups</b>				
	Predicted Thyroid exposure(cGy)	KI dose (mg)	# of 130 mg tablets	# of 65 mg tablets
Adults over 40 yrs	$\geq 500$	130	1	2
Adults over 18 through 40 yrs	$\geq 10$			
Pregnant or lactating women	$\geq 5$	65	1/2	1
Adoles. over 12 through 18 yrs*				
Children over 3 through 12 yrs				
Over 1 month through 3 years				
Birth through 1 month	16	1/8	1/4	

\*Adolescents approaching adult size ( $\geq 70$  kg) should receive the full adult dose (130 mg).

# Surviving the Longer Fallout



- Concern for radioactive dust carried high aloft for months or more.
- Concern for shielding of SUNLIGHT = “nuclear winter” and reduced crop production...BIG reduction in crop production.
- More sensitive radiation detectors (geiger counter?) may be useful to assess plants/animals/food – there are very long half-life fission and irradiation products that will remain for years.... Many years.



# Ionization Secondary To Attack



An explosion in the lower ionosphere of a nuclear bomb in the megaton range will convert midnight ionization conditions into noon conditions. *As a result long-range transmissions in the region 100 kc/sec to 2 Mc/sec suffer appreciable attenuation and are likely to be unserviceable not only for the whole night but also for the next night or two.* **HF ionospheric communications are also severely affected and a virtually complete black-out occurs over an area of some 10 million square kilometers for some hours.** It would appear that the higher HF frequencies say, 20 Mc/sec, will escape full extinction if their point of reflection is at least 1000 km from the explosion. On the other hand, there is no reason to suppose that VHF ionosscatter links would have suffered to any measurable degree. In order to black out ionosscatter communications with certainty, the bomb must have some 100 times the residual radioactivity. The proportion of fission material in the Johnston Island 4-MT bomb is not known, but it seems probable that this factor of 100 would require a "dirty" bomb with a power of some 40 MT. (auth)

Ref: <https://www.osti.gov/biblio/4082181-effect-nuclear-explosions-radio-communication>

SOME OBSERVATIONS OF MF AND HF RADIO SIGNALS AFTER MID-PACIFIC HIGH-ALTITUDE NUCLEAR EXPLOSIONS, G C Andrew

# 1962 Article



- <https://www.tandfonline.com/doi/pdf/10.1080/00288306.1962.10420054>
- 1959 Kingan – no MF (0.3-3 MHz) broadcast reception x 5 days; 30MHz & above suddenly worked GREAT for DX
- 1959 – burst height 26 mi: 7 days of zero MF; 5000 km DX on 50 MHz!
- 1962 Dixon – severe attenuation of MF signals
- 1959 Coroniti & Pierce: 13.75 MHz 20db signal degradation over DX path
-

# Tropospheric Nuclear Explosion Conclusion



- It would appear that ionising radiations from higher-yield nuclear explosions at tropospheric heights on 14 June and 30 June, one at least of which was in the megaton range, were sufficiently great to traverse the relatively dense atmosphere and **penetrate to the D region of the ionosphere with resultant marked absorption of radio signals in the Pacific area and particularly of those with a path near the explosion.**
- More recent nuclear tests in the troposphere have confirmed this

# Ionospheric level of nuclear explosion



- Temporary degradation as much as 30dB in mid HF signals. Lasting small number of hours
- Longer-term variable impacts
- Tendency toward better propagation at abnormally higher HF or low VHF frequencies
-

# Radio conclusion

- D layer significant enhancement for DAYS renders low HF frequencies (3 MHz etc) relatively unusable
- F layer enhancement may allow much higher MUF and use of unexpectedly high frequencies for single digit days
- Variable impact at normal HF DX frequencies
- Unlikely to effect 70 cm ham radio (point to point)



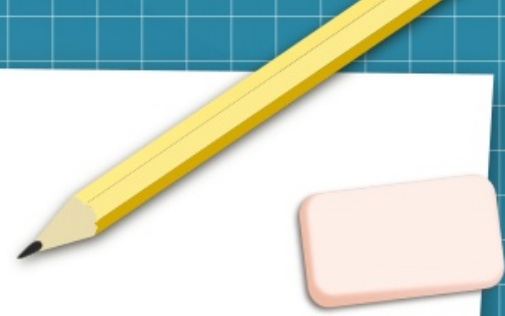
# Volunteer Response

- First few days: Radio comms indoors, avoiding radiation.
- Anything to say? Doubtful. Monitor for civil defense information on dosage rates, solutions for those with poor safe rooms.
- Little that you can do to help others.
- Utilities may cease. Anyone from outside must strip / shower / reclothe



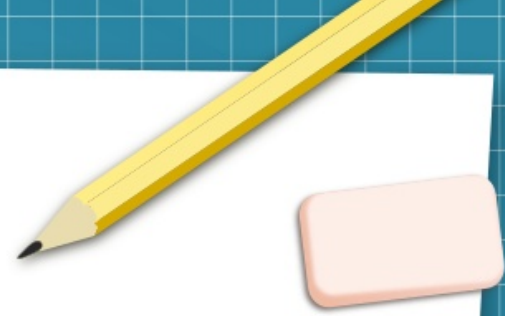
## Later Response (> 3 days)

- ? Will civil government survive? Police? Fire?
- Reporting function for volunteers?
- Possibility of assisting in radio comms if internet /etc fail?
- Very little chance of reconstruction of utilities early on.
- EOC or volunteer reporting to State / Federal?



# If civil government fails

- Neighborhood protection?
- Deal with wounded?
- Travel dangerous?
- Deal with food / water issues? (Well water will be safe)
- City sewage likely to stop flowing
- Security issues?
- Gradual reconstruction of civil association?







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